Prevalence of alcohol and other psychoactive substances in injured and killed drivers

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Prevalence of alcohol and other psychoactive substances in injured and killed drivers

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Executive Summary

Introduction. The European Integrated Project DRUID (Driving Under the Influence of Drugs, Alcohol and Medicines) is a part of the 6th Framework Program, the European Community Framework Program for Research, Technological Development and Demonstration. The objective of DRUID is to give scientific support to the EU transport policy by providing a solid basis to generate harmonised, EU-wide regulations for driving under the influence of alcohol, drugs and medicine. This study is a part of Work Package 2, Epidemiology, of the DRUID project. The objective of the study is to assess the situation in Europe regarding the prevalence of alcohol and other psychoactive substances in drivers who have been injured/killed in traffic accidents.
Part 1 of this report presents the general results of the hospital & killed driver studies. After a short introduction, the representativeness of the populations in the EU countries as well as the representativeness of hospitalised and killed driver samples are addressed. An overview of the non-response issues in the various countries is also included. Based on the toxicological findings, a general summary of the prevalence of drug use is given for the 9 participating countries. This is followed by a discussion and a conclusions part.
Part 2 and 3 of this report include all the country reports. In this part more detailed information regarding study design, methods, representativeness of the sampling and results on a national level can be found.

Material and Method. A cross-sectional survey was conducted to determine the prevalence of drugs in injured (sampled between October 2007 and May 2010) and killed (sampled between January 2006 and December 2009) drivers in 9 European countries. In order to be able to compare the 10 different studies (Finland performed an injured driver study and a killed driver study), a uniform design was developed for all participating countries (see Annex 1). Obligatory inclusion criteria were: Driver of a motorized vehicle, injured in an accident on a public road or in the direct vicinity of a public road, only primary admissions to the hospital (no referrals), because of traumatological reasons with a time interval between the accident and sampling of less than 3 hours and a injury severity being MAIS 2 or higher. Each country could decide upon additional national criteria.
A total of 3570 seriously injured drivers and 1293 killed drivers were sampled in this study. For the general outcomes, among all subjects sampled, a selection was made to obtain relatively similar sub-populations of seriously injured (MAIS ≥2) and killed drivers. The analysis focuses on drivers of personal cars and vans.
Drug dosage was conducted on blood samples. Extraction was based on liquid-liquid (LLE) or solid phase (SPE) extraction, chromatographic separation was performed by gas chromatography (GC) or liquid chromatography (LC): *High Performance (HPLC) or Ultra Performance (UPLC).* Detection was done by mass spectrometry (MS) or nitrogen/phosphorus detection (NPD). Commonly defined DRUID thresholds were used to define positivity (part 1, 2.2. toxicology). Prevalence data were also provided according to age and gender.

Results
In the **injured drivers** study, among car and van drivers (n= 2492), the highest number of subjects was sampled in Denmark (33.7%), followed by Italy (27.1%). Disregarding the Belgian data (classification of road type based on speed limit), 26.5% of drivers were sampled on urban roads, 29.2% on rural roads and 44.3% on unknown type of road. 76.9% of the accidents occurred during daytime (50.9% on a weekday, 26% in weekends). More than 50% of the drivers were sampled in the first or fourth quarter. For Italy there was a higher proportion in the second quarter and a lower one in the fourth quarter compared to other countries. Males accounted for 69.9%, females for 29.5% (0.6% unknown). 79.7% of the study population was between 18 and 49 years old. The

use of safety belt was known for only 17.8% of the sampled drivers (Belgium and the Netherlands) and of these approximately 72% were using a safety belt. Overall 90.8% of the study population was driving a personal car and 5.8% a small van (3.4% unknown). 32.3% was involved in a single-vehicle accident and 37.3% in a multi-vehicle collision (30.4% unknown). The most prevalent MAIS scores were 2 and 3.

In the **killed drivers** study, among car and van drivers (n= 1118), the highest number of subjects was sampled in Finland (43.2%), followed by Portugal (25.5%). 63.5% of the population was sampled on rural roads, 10.1% on urban roads (26.4% unknown). 78% of the accidents occurred during daytime (53% on a weekday, 25% in weekends). The distribution by quarter of the year was equal between all countries, with the highest percentage in the third quarter. Males accounted for 83%. The highest proportion was found in the group 50 years and older. Overall 70.8% of the study population was driving a personal car. 30.9% was involved in a single-vehicle accident and 43.5% in a multi-vehicle collision (25.6% unknown).

Toxicological data were analysed according to two criteria.

- Distribution of positive drivers among sampled subjects (mutually exclusive groups): a subject can be part of one group only, independently of the number of substances taken.
- Prevalence of substance groups use among sampled drivers: data give an indication of how many people use the different substance groups among the sample population and the same subject may appear under several substance groups.

The percentages of drivers positive for one or more substances (mutually exclusive) varied from around 28% up to 53% in the different countries, as shown in the table below.

MUTUALLY EXCLUSIVE GROUPS - Percentage of drivers positive for the substance groups										
	Seriously injured drivers						**Killed drivers**			
Toxicological finding	**BE (325)**	**DK (831)**	**FI (47)**	**IT (676)**	**LT (385)**	**NL (186)**	**FI (459)**	**NO (165)**	**PT (285)**	**SE (141)**
Negative	47.4	69.7	55.3	68.0	72.2	66.1	57.7	60.0	52.3	69.5
Alcohol only	30.2	14.1	25.5	18.5	15.3	25.3	24.4	18.2	38.9	15.6
Amphetamine only	0.9	1.0	0.0	0.0	0.3	1.1	0.7	1.2	0.0	2.1
Benzoylecgonine only	0.0	0.0	0.0	0.7	0.3	1.1	0.0	0.0	0.0	0.0
Cocaine	0.0	0.0	0.0	0.6	0.3	0.0	0.0	0.0	0.0	0.0
THCCOOH only	0.6	1.6	0.0	0.4	0.3	0.0	N.A.	N.A.	1.1	0.0
THC	1.5	0.6	2.1	1.6	0.3	0.5	0.0	1.8	0.0	0.7
Illicit opiates only	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
Benzodiazepines only	1.5	1.2	0.0	0.4	2.3	0.0	5.2	1.8	0.7	0.0
Z-drugs only	0.9	0.5	2.1	0.0	0.0	0.5	1.7	1.2	0.0	2.8
Medicinal opioids only	1.2	2.5	0.0	1.8	5.7	0.5	1.5	0.6	0.7	0.7
Alcohol + drug combination	13.2	5.4	10.6	4.6	2.3	4.3	7.2	7.9	6.0	4.3
Drug + drug combination	2.5	3.5	4.3	2.5	0.8	0.5	1.5	7.3	0.4	4.3
Total	100	100	100	100	100	100	100	100	100	100

As expected, alcohol was the most common toxicological finding, both in the seriously injured and in killed drivers (range 17.7 - 42.5% and 19.0 - 44.9% respectively for the injured and killed drivers study). In the prevalence of use, among all seriously injured drivers, after alcohol, THC (range 0.5-7.6%) and benzodiazepines (range 0-10.2%) were the most common findings. In the killed drivers study, among all sampled subjects, the most prevalent substances after alcohol were benzodiazepines (range 1.4-13.3%), followed by amphetamine (range 0-7.4%) and THC (range 0-6.1%). These results are shown in the table below.
To be able to give a better view on sporadic/single or chronic use of cannabis, a distinction between THC and THCCOOH was made.

PREVALENCE OF USE OF SUBSTANCE GROUPS - Percentage of drivers positive										
	Positive seriously injured drivers						Positive killed drivers			
	BE	DK	FI	IT	LT	NL	FI	NO	PT	SE
Alcohol (≥0.1g/L)	42.5	19.7	32.1	23.1	17.7	29.6	31.4	25.4	44.9	19.0
Alcohol (≥0.5 g/L)	38.2	17.8	30.2	20.6	16.1	28.0	29.3	23.8	35.1	16.3
Amphetamines	2.6	4.2	3.7	0.1	0.5	2.1	2.1	7.4	0.0	6.6
Benzoylecgonine*	1.4	0.7	0.0	2.8	0.3	2.7	0.0	0.6	0.7	0.7
Cocaine	2.3	0.6	0.0	2.7	0.3	2.1	0.0	0.0	0.7	0.7
Cocaine and/or benzoylecgonine	3.8	1.3	0.0	5.4	0.5	4.8	0.0	0.6	1.4	1.3
THCCOOH**	2.3	5.3	0.0	1.3	0.3	1.1	N.A.	N.A.	4.2	0.0
THC	7.6	1.3	5.7	3.7	0.5	0.5	1.3	6.1	0.0	1.3
THC and/or THCCOOH	9.9	6.6	5.7	5.1	0.8	1.6	1.3	6.1	4.2	1.4
Illicit opiates	0.6	0.5	0.0	2.1	0.3	0.0	0.0	0.0	0.0	0.0
Benzodiazepines	7.3	6.7	10.2	0.7	3.6	0.0	13.3	9.7	1.8	3.9
Z-drugs	1.7	1.2	3.8	0.0	0.0	0.5	3.0	4.4	0.0	3.2
Medicinal opioids	3.3	4.2	4.0	3.7	7.8	0.5	2.1	1.7	2.1	4.1

* Benzoylecgonine but negative for cocaine
**THCCOOH but negative for THC

Highlights

Seriously injured drivers

- The percentage of subjects testing positive for at least one psychoactive substance ranged between 28 and 53%.
- Alcohol (cut-off = 0.1 g/L) was the most common finding with the highest percentage of positives found in Belgium (42.5%), where 50.6% of the male injured drivers tested positive. Among the positives, 90.5% had a blood alcohol concentration equal to or above 0.5 g/L. The mean and median values of ethanol were respectively 1.59 g/L and 1.60 g/L
- The majority of drugs appeared to be used in combination with other psychoactive substances.
- Among the illicit drugs, amphetamine use appeared to be more common in northern Europe, while cocaine use seemed to be more prevalent in southern Europe. No cases of cocaine/benzoylecgonine were recorded in Finland.
- Approximately 9.9 % of the seriously injured drivers in Belgium tested positive for cannabis (THC and/or THCCOOH).
- No positive findings for Z-drugs were recorded in Italy and Lithuania.
- Lithuania had almost a double amount of positive subjects for medicinal opioids compared with the other countries in the study.

Killed drivers

- The percentage of subjects testing positive for at least one psychoactive substance ranged between 31 and 48%.

- Alcohol (cut-off = 0.1 g/L) was the most common finding with the highest percentage of positives found in Portugal (44.9%). Among the positives, 87.3% had a blood alcohol concentration equal to or above 0.5 g/L. The mean and median values of ethanol were respectively 1.61 g/L and 1.67 g/L.
- In Portugal no subjects were found positive for the amphetamine group.
- The majority of drugs appeared to be used in combination with other psychoactive substances.
- No drivers tested positive for cocaine in Finland.
- Subjects positive for THC (alone or in the presence of THCCOOH) were only found in males.
- Norway had the highest percentage of positive findings for THC (6.1%).
- In Portugal no subjects tested positive for Z-drugs.
- Sweden had a double amount of subjects positive for medicinal opioids compared with the other three countries.

Comparing the two Finnish datasets percentages in the seriously injured and in the killed drivers studies, similar findings were observed for most substance groups.

Discussion.

Non response. The non response in the six countries involved varies between 0% and 8.5% for the surveys on injured drivers. The missing cases in the studies on killed drivers varied between 5.7% and 41%.

*Representativeness***.** Every country made several efforts to have a representative driver sample. These efforts resulted in a high participation rate in the injured driver surveys and in a maximum of 41% missing cases in the killed driver studies. Concerning the representativeness of the population in the EU countries: the Southern EU Member States are the best represented (54%), followed by the Northern Member States (29%) (due to the absence of the United Kingdom which alone accounts for 63% of the Northern Europe population). The Western Member States are only represented for 15% since large Member States like Germany and France, accounting together for 80% of Western Europe population, did not participate. Finally, the Eastern EU Member States are not represented in this study.

Remarks.

- The selection of countries was based on the institutes that participated in DRUID and based on their experience in organising hospital studies. During the negotiation progress, it was asked by the European Commission to also include southern and eastern European countries. Because of difficulties in organising previous similar studies, some countries decided not to participate in this DRUID-survey. Sweden and Hungary were at the beginning involved in the hospital study. Because of problems in cooperation with hospitals, these countries were allowed ot change their involvement. Instead of a hospital study, Sweden performed a killed driver study and Hungary a responsibility study on killed drivers.
- In the killed drivers study the prevalence of cannabis use in Norway and Finland may have been underestimated due to the fact that samples were not analysed for THCCOOH.
- A sample was considered positive for alcohol when the concentration was at or above the DRUID cut-off, which was set at 0.1 g/L. In most countries the legal cut-off for alcohol is 0.5 g/L. For the injured drivers study 9.5% of alcohol positive samples was found to have a concentration in the range 0.1-0.49 g/L. For the killed drivers study the percentage of positives in the same concentration range was 12.7.
- Samples were considered positive if a substance was found at or above the set DRUID cut-offs. For this reason, the data give an estimate of the prevalence of substance groups among the sampled populations, which is likely to be conservative, because samples that tested positive but below the set cut-off were considered as negative.

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List of Abbreviations

Abbreviation	Full Description
BAC	Blood Alcohol Concentration
BE	Belgium
BBTS	Belgian Toxicology and Trauma Study
C&V	Personal cars and vans
DK	Denmark
DTU	Technical University of Denmark
DUI	Driving under the influence
EEA	European Economic Area
EI	Electron ionisation
F	Female
FI	Finland
GC	Gas chromatography
GC-MS	Gas Chromatography-mass spectrometry
HPLC	High Performance Liquid chromatography
HS	Hospital Survey
INML,IP	National Institute of Legal Medicine (Portugal)
IT	Italy
LC	Liquid chromatography
LOD	Limit of detection
LOQ	Limit of quantitation
LLE	Liquid-liquid Extraction
LT	Lithuania
M	Male
MAIS	Maximum Abbreviated Injury Scale
MDA	3,4-methyleendioxyamphetamine
MDEA	3,4-methylenedioxy-N-ethylamphetamine
MDMA	3,4-Methylenedioxymethamphetamine
MSD	Mass Selective Detector
N.A.	Not applicable
NCI	Negative chemical ionisation
NIPH	Norwegian Institute of Public Health
NPD	Nitrogen Phosphorus Detector
NL	The Netherlands
NO	Norway
OF	Oral Fluid
PASW	Predictive Analytics SoftWare
PrT	Proficiency testing
PT	Portugal
RR	Response Rate
SE	Sweden
SPE	Solid phase Extraction
THC	delta-9-tetrahydrocannabinol
THCCOOH	11-nor-9-carboxy-delta-9-tetrahydrocannabinol
THL	National Institute for Health and Welfare (Finland)

TMI	Institute for Forensic Medicine Mykolas Romeris University (Lithuania)
UKBH	The University of Copenhagen
UPLC	Ultra Performance Liquid chromatography
UPLC-MS/MS	Ultra Performance liquid chromatography tandem mass spectrometry
VALT	Finnish Motor Insurers' Centre

Part 1 – Summary Report

1 Introduction

1.1 DRUID Project

The European Integrated Project DRUID (Driving Under the Influence of Drugs, Alcohol and Medicines) is a part of the 6th Framework Program, the European Community Framework Program for Research, Technological Development and Demonstration. The DRUID project focuses on the improvement of road safety related to the problem of alcohol, drugs and medicines used or abused by drivers of vehicles in the road transport system. The objective of DRUID is to give scientific support to the EU transport policy by providing a solid basis to generate harmonised, EU-wide regulations for driving under the influence of alcohol, drugs and medicine. This study is a part of Work Package 2, Epidemiology, of the DRUID project.

1.2 Work Package 2 – Epidemiology

The objective of this work package is to assess the situation in Europe regarding the prevalence of alcohol and other psychoactive substances in drivers in traffic in general and in drivers who have been injured/killed in traffic accidents. Additionally, the characteristics of drivers who have been involved in accidents while impaired by alcohol or other psychoactive substances were explored. Furthermore relative risk estimates for traffic accident involvement of drivers impaired by alcohol and other psychoactive substances, who have been responsible for fatal accidents, were made. Finally differences in the patterns of psychoactive substance use between various EU countries were examined. The main purpose of the epidemiological studies was to determine the accident risk when driving under the influence of psychoactive substances, including alcohol (DUI).

1.3 Task 2.2b

This task studies drivers who have been injured and/or killed in traffic accidents. The prevalence of alcohol and/or various psychoactive substances among accident-involved drivers was assessed by means of two different populations (injured and killed drivers).
The study was carried out in Belgium, Denmark, the Netherlands, Italy, Lithuania (injured drivers), Norway, Sweden, Portugal (killed drivers) and Finland (injured and killed drivers). For some countries samples from injured and/or killed drivers were collected in the same periods and geographical areas as for the roadside surveys (subtask 2.2a). Samples were either collected at hospitals, at the accident sites, or during legal autopsies. Toxicological analyses were carried out on a total of 4857 blood samples from injured and/or killed drivers collected in the 9 countries involved in subtask 2.2b. Samples were tested for the presence of the same substances analysed in the roadside surveys, and the results serve as reference data for the relative risk estimation (odds ratio calculation) of alcohol and other psychoactive substances.

Table 1. Participating countries and number of samples

Injured drivers		Killed drivers	
	Samples		**Samples**
Belgium	1078	Finland	652
Denmark	856	Norway	193
Finland	325	Portugal	290
Italy	690	Sweden	158
Lithuania	424		
Netherlands	197		
Total	3570		1293

Figure 1. Participating countries

All participating countries are members of the European Union (EU) except for Norway, which is associated with the European Union as a member of the European Economic Area (EEA).

2 Methods

2.1 Driver sampling

2.1.1 Description of the sampling method

2.1.1.1 Injured drivers

In general a blood sample was taken by hospital staff on arrival during the normal emergency procedure. At that stage the patient may not have been informed or asked permission, because unconscious. Informed consent was mandatory in some of the participating countries. If the patient refused to participate in the study, the blood sample was destroyed. If the patient took part in the study, a form including obligatory criteria (see annex 1) and additional data were filled in.

The **Belgian** national database includes injured drivers who were admitted in one of the following hospitals: Ghent University Hospital, Regional Hospital of Namur, University Hospital Sart Tilman (Liège), Leuven University Hospital and Brussels University Hospital. These 5 hospitals were selected because they participated in a previous similar study (Belgium Toxicology and Trauma Study) in 1995. Samples were collected from drivers hospitalised between January 2008 and May 2010. Medical staff was in charge of filling in a patient form for each participant. Informed consent was mandatory.

In **Denmark** the emergency room secretary controlled, on arrival by ambulance of the patient in one of the five selected hospitals, whether the patient was driver of a passenger car or a van. If this was the case, the emergency room secretary filled in a patient datasheet and the laboratory technician took besides the samples for treatment purposes an additional blood sample. Driver participation in the hospital study was, in principle, voluntary, without the need of an informed consent.

The **Finnish** data were collected in southern Finland at two hospitals whose catchment areas covered the counties of Uusimaa and Itä-Uusimaa. Sample collection and interviews were carried out at the hospitals by nurses, who then sent the samples and interview forms to National Institute for Health and Welfare (THL). Patients included in the study were drivers of a motor vehicle or a bicycle and had a MAIS of 1 and above. To ensure efficient recruiting of patients and a high inclusion rate, all injured drivers over 18 years old, even if only slightly injured, were asked to participate. Informed consent was mandatory.

The **Italian** survey was carried out in close co-operation with the local hospitals. A selection of hospitals was made on the basis of willingness to cooperate, geographical distribution and influx of injured drivers. Only drivers that matched a number of well-defined inclusion criteria were selected.

In **Lithuania** a uniform protocol for hospital survey was used by the four participating hospitals in Vilnius, Kaunas, Klaipeda and Alytus. Responsible persons were appointed in each hospital. Blood samples were collected from injured drives and sent to the TMI Toxicology laboratory with the filled questionnaire.

Hospitals in Enschede, Nijmegen and Tilburg participated in the study in the **Netherlands**. These hospitals collected accident and demographic data plus blood

samples from seriously injured drivers of passanger cars and vans who were admitted to the hospitals' Emergency Department.

Table 2. Description of sampling method - Injured drivers

Injured drivers		
Country	**Sample**	**N Hospital + who collected**
Belgium	Blood	5 hospitals; by appointed medical staff
Denmark	Blood	5 hospitals; by medical staff
Finland	Blood/oral fluid	2 hospitals; by medical staff
Italy	Blood/Urine	4 hospitals; by medical staff
Lithuania	Blood	4 hospitals; by appointed medical staff
Netherlands	Blood	3 hospitals; by medical staff

2.1.1.2 Killed drivers

In **Finland** the data concerning the accidents was collected from the Finnish Motor Insurers´ Centre (VALT). VALT is the agency which collects and holds information gathered by accident investigation teams in Finland. When toxicological analytical information for killed drivers could not be retrieved from the VALT archives the autopsy reports were requested from the Department of Forensic Medicine, Helsinki University, which performs forensic autopsies for the whole of Finland. In these instances the information for respective cases was then matched and collated to one database.

In **Norway** data on persons injured or killed in road traffic accidents are submitted by the police to Statistics Norway on a regular basis. These data are entered into the Norwegian Road Accident Registry. Data on biological samples submitted for forensic analysis of alcohol or drugs at the Norwegian Institute of Public Health (NIPH) are recorded in the Forensic Toxicology Database at NIPH. In addition, analytical data from samples taken from legal autopsies from all regions of the country except Trøndelag in central Norway (which comprises two counties and 8.7% of the total population in Norway) are included in this database. A new dataset was generated by coupling these two databases, selecting drivers of passenger cars and vans who had been killed in road traffic accidents in Norway from January 2006 to December 2008.

The cases included in the **Portuguese** study correspond to drivers victims of fatal road accidents on which autopsy was carried out in the Centre and South Branches of the Medico Legal Offices of the National Institute of Legal Medicine (INML, IP). As established by Law 45/2004, the National Institute of Legal Medicine is responsible for the medico-legal autopsies, which are mandatory in the cases of drivers killed in immediate fatal accidents. The cases selected for the present study were those classified as road accidents in which the driver was the victim and for which the toxicological analysis previously requested included alcohol, illicit drugs and medicinal drugs (benzodiazepines). Information about vehicle type could not be gathered but it is assumed that app. 95% of the sampled subjects were drivers of a passenger car or a van.

All people killed in road traffic accidents in **Sweden** should undergo a post-mortem examination. In practice, about 90 per cent are examined. The Swedish sample includes drivers of personal cars and vans that were killed during the year 2008 and died within 24 hours after the accident. The examination is carried out at the National Board of Forensic Medicine and, if possible, samples of blood, urine and sometimes other material are collected and sent to the department of Forensic Toxicology, which performs a toxicological analysis. The list of substances tested for is not standardised and may differ

between drivers. Additional analyses were therefore carried out in order to cover the DRUID substances.

Table 3. Description of sampling method - Killed drivers

Killed drivers		
Country	**Sample**	**Organisation that collected samples**
Finland	Blood	VALT + Department of Forensic Medicine, Helsinki University
Norway	Blood	One database was created by Statistics Norway with: - Data on persons submitted by the police to Statistics Norway - Data on biological samples submitted to the Forensic Toxicology Database (NIPH[1])
Portugal	Blood	National Institute of Legal Medicine
Sweden	Blood/Urine[2]/Muscle tissue[3]	National Board of Forensic Medicine. Analysis by the department of Forensic Toxicology.

2.1.2 Representativeness of the population in the EU countries

In 2008, when the collection for this study started, the European Union consisted of 27 Member states with a total population of 497 million inhabitants (Source: Eurostat).

According to the United Nations geoscheme, the region Europe can be devided in four geographical sub-regions, which do not imply any assumption regarding political or other affiliations of countries or territories. These sub-regions are commonly used for statistical purposes.

Table 4. Coverage of the EU per sub region by the participating countries

EU Member States per European sub region		Number of inhabitants (million)	Participation in the hospital study (X = yes)	Representative-ness per European sub region
Northern Europe				29%
	United Kingdom (UK)	60.9		
	Sweden (SE)	9.0	X	
	Denmark (DK)	5.4	X	
	Finland (FI)	5.3	X	
	Norway* (NO)	4.8	X	
	Ireland (IE)	4.3		
	Lituania (LT)	3.4	X	
	Latvia (LV)	2.3		
	Estonia (EE)	1.3		
Eastern Europe				0%
	Poland (PL)	38.2		

[1] NIPH= Norwegian Institute of Public Health
[2] In some cases, screening results from urine haven been reported. This was only done when the screening gave a negative result and when there was not enough blood to conduct the analyses.
[3] Results from analyses on muscle tissue have also been reported in a few cases there was not enough blood to conduct the analyses

Romania (RO)	21.6		
Czech Republic (CZ)	10.3		
Hungary (HU)	10.1		
Bulgaria (BG)	7.7		
Slovakia (SK)	5.4		
Southern Europe			54%
Italy (IT)	59.1	X	
Spain (ES)	44.5		
Greece (EL)	11.2		
Portugal (PT)	10.6	X	
Slovenia (SI)	2.0		
Cyprus (CY)	0.8		
Malta (MT)	0.4		
Western Europe			15%
Germany (DE)	82.3		
France (FR)	63.4		
The Netherlands (NL)	16.3	X	
Belgium (BE)	10.6	X	
Austria (AT)	8.3		
Luxembourg (LU)	0.5		
Total	500.0		

* Norway is not a member of the EU. Norway is associated with the European Union as a member of the European Economic Area (EEA).

Table 4 presents an overview of the EU Member States plus Norway and the geographical European sub-regions to which they belong. In this table the coverage of the participating countries is presented for the EU and for each geographical region that is covered by the EU Member States. Based on the population numbers it is shown that the Southern EU Member States are the best represented (54%). The Northern Member States together with Norway are represented for 29% due to the absence of the United Kingdom which accounts for 63% of the Northern EU Population. The Western Member States are only represented for 15% since large Member States like Germany and France, accounting together for 80% of the total Western EU population, did not participate. Finally, the Eastern EU Member States are not represented in this study.

2.1.3 Representativeness of the hospitalised/killed driver samples

2.1.3.1 Injured drivers

For prevalence calculations, the **Belgian** data were grouped under the three administrative Belgian regions (Brussels, Flanders and Wallonia), so that they could be compared with the data collected during the roadside survey.[4] Overall, only 3.2% of

4 Geographic distribution of roadside sessions was performed systematically. An equal number of sessions was scheduled in the catchment area of each hospital participating in DRUID task 2.2.b. For practical reasons, it was decided to include 9 police zones in each catchment area. These areas were defined based on information from the emergency services.

drivers were sampled in Brussels, while 81.3% were sampled in Flanders and 15.5% in Wallonia. This sampling distribution is significantly different from the one obtained in Flanders and Wallonia during the roadside surveys. The roadside figures are comparable with the distribution of vehicle kilometres in these regions (see D 2.2.3).

The total number of seriously injured drivers for whom both a datasheet was received in **DTU (Denmark)** and a blood sample was received in UKBH was 856. Drivers below the age of 18 and drivers for whom the blood sample was taken three hours or more after the accident took place were excluded. A total of 840 drivers were included in the study.

All **Finnish** hospital survey samples were collected in southern Finland at two hospitals whose catchment areas covered the counties of Uusimaa and Itä-Uusimaa. About 28% of the Finnish population lives within this area. According to national statistics, 8513 people were injured in traffic accidents in 2008 and of these 26% within the catchment areas. The overall participation rate was 82.9% (325 injured drivers consented from 392 potential cases). The actual consent rate would increase to 91.5%, if it is considered that the number of potential participants decreases to 355 excluding those patients who did not refuse to take part in the study, but had to be excluded for other reasons (e.g. under 18, transferred to another hospital before interview could be completed).

The following specific districts were included in the **Italian** road side survey: Padova, Rovigo, Treviso, Venice, and Vicenza, accounting for more than 8% of the entire population in Italy and in 4 out of 5 districts could a hospital be selected for the hospital survey. The choice of these districts was based on the geographical distribution of population over the country. The four provinces cover all the geographical areas and reflect the Italian general topography. The social and economic structure of the region comprises agricultural, industrial and tourism activities thus representing a good model of the Italian socioeconomic configuration as well. Since it was stressed that the questionnaire was anonymous and all necessary efforts were made to guarantee the privacy of the patient and the confidentiality of the doctor-patient relation, non-response in collecting blood was reduced to zero.

The four main hospitals of **Lithuania** (in Vilnius, Kaunas, Klaipeda and Alytus) were involved in the hospital study. These research areas of Lithuania were based on the geographical distribution of population over the country, accounting for 3,350 mln. inhabitants in total. The total number of injured drivers involved in Lithuanian hospital study was 424 drivers. During the hospital study there were no non-responses or refusals. The response rate was 100%.

In the **Netherlands** the study area covered only the South and Eastern part of the Netherlands, but not the North and Western part. Based on the distribution of psychoactive substances in traffic in all regions, the expected bias was very small.

2.1.3.2 Killed drivers

The data presented in the **Finnish** Country Report is almost fully comprehensive for the three years 2006 to 2008. Therefore it can be assumed that these results are representative of the situation regarding killed drivers of motorised vehicles and bicycles in Finland.

Norway was divided into three regions. About 53% of the cases were from south-east, 25% from south-west, and 22% from middle/north. As comparison, in December 2008 about 54% of all cars and vans were owned by drivers in south-east, 23% in south-west, and 23% in middle/north according to Statistics Norway (www.ssb.no). In the period 2006-2008, a total of 328 drivers of cars and vans at the age of 18 years or older were

killed in road traffic accidents in Norway. Blood samples were submitted to NIPH for analysis of alcohol and drugs in 193 of those cases (59%); the data presented in the Norwegian report are based on those cases only. Blood samples were taken shortly after the accident from 100 drivers and during legal autopsy from 93 drivers.

The **Portuguese** data include 79% of the total killed drivers autopsied in National Institute of Legal Medicine (INML), during the year 2009. The sampling distribution is different from the one obtained in the Road Side Survey and covers all Municipalities of the Centre and South regions, an area where about 71% of Portuguese population lives.

During the study period, year 2008, 178 drivers of personal cars or vans were killed in road traffic accidents in **Sweden** and 170 (96%) of these did undergo a post-mortem examination, 11 cases were excluded because they died more than 24 hours after the accident. The final database for the study includes 158 cases for which patient data and/or toxicological data were available. The study area covers the whole of Sweden and the representativeness of the sample is very good since almost all killed drivers were included (ca 94%).

2.1.4 Non-response problems

Non response bias is often an issue in epidemiological studies. It often occurs if those who respond to the survey differ in the use of drugs from those who do not respond. The presence of non response bias is difficult to evaluate, but a comparison of data on age, gender, and time period between respondents and non responders could provide some information. In the DRUID prevalence studies non response varies not only between the two different studies (killed vs seriously injured drivers) but also between countries in the same study.

The non response in the six countries varies between 0% and 8.5% for the surveys on the injured drivers. Missing cases varies between 5.7 and 41% for the studies on the killed drivers.

In general two different types of reasons for the size of non-response can be given: non-response as a result of the study design and non-response as a result of external factors.

A first study design factor is the choice of body fluids to be collected. As in the injured drivers study the collection of blood/urine is part of a routine during emergency procedure by medical staff, this factor was likely to have a minimum influence on the response rate.

A second factor relates to the voluntary character of the survey. In 3 of the 6 countries involved in the injured drivers study an informed consent had to be signed by the driver or a relative. The need for such a written informed consent can be expected to have a negative influence on the response rate. However looking at the data of Belgium, Finland and Italy, where informed consent was needed, non response was limited to a maximum of 8.5%.

Table 5. Study design and non-response – Injured drivers

INJURED DRIVERS						
Country	**Sample**	**Collection**	**Mandatory**	**Informed consent**	**Non-response percentage**	**Missing**
Belgium	Blood	Hospital staff	No	Yes	5.4%	105 cases
Denmark	Blood	Hospital staff	No[5]	No	Unknown[6]	60 cases
Finland	Blood/oral fluid	Hospital staff	No	Yes	8.5 %	No missing cases reported
Italy	Blood/Urine	Hospital staff	No	Yes	0%	No missing cases reported[7]
Lithuania	Blood	Hospital staff	No	No	0%	No missing cases reported
Netherlands	Blood	Hospital Staff	No	No	Unknown[8]	No missing cases reported

Besides study design factors, external factors have also an influence on the outcome of the survey. These factors cannot be included in the study design, and might result in missing cases.
For example, in some countries the police was in charge for sending samples to the laboratory responsible for the analysis. When the police considered that the probability of finding alcohol or drugs was low, no samples were sent to the laboratory, resulting in a missing case.

In the case of killed drivers, post-mortem examination is mandatory in Portugal, Finland and Sweden for all people killed in road traffic accidents. However, in practice less than 100% of the cases are analysed. For this reason these three countries have a lower percentage of missing cases compared to Norway where sampling is not mandatory.

Table 6 present an overview of the missing cases per country that performed a study on killed drivers.

[5] Driver participation in the Danish study was in principle voluntary. However, the blood sample was taken on arrival during the normal procedure for blood samples, and the patient was not informed or asked. Because of the severity of injuries, some of the trauma patients were even unconscious at the sampling time. DTU prepared an information leaflet for the patients. It was however the decision of the hospital whether patients should receive information. In those hospitals were they did inform the patient, the patient could refuse to participate (non-response).
[6] No registration of the patients that refused is available
[7] Lack of accident data such as road type, accident type,.. is reported
[8] No information of non-respond(ers) could be retrieved from the hospitals

Table 6. External factors and refusals – Killed drivers

KILLED DRIVERS						
Country	**Sample**	**Collection**	**Mandatory**	**Informed consent**	**Non-response percentage**	**Missing**
Finland	Blood	VALT[9] Department of Forensic Medicine, Helsinki University	Yes	n.a	n.a.	5.7%
Norway	Blood	Data on persons are submitted by the police to Statistics Norway Data on biological samples are submitted at the Forensic Toxicology Database (NIPH[10])	No	n.a	n.a.	41%
Portugal	Blood	National Institute of Legal Medicine	yes	n.a	n.a.	21%
Sweden	Blood/Urine[11]/Muscle tissue[12]	National Board of Forensic Medicine. Analysis by the department of Forensic Toxicology.	yes	n.a	n.a.	6%

na: not-applicable

2.1.4.1 Injured drivers : problems encountered

In **Belgium** 105 additional respondents had to be excluded from the database as no blood sample was available for toxicological analysis; they are reported as missing cases. For 67 people a patient form was filled in, but they refused to give a blood sample for toxicological analysis. For some other subjects, who refused to take part in the study, no form may have been filled in. Because of the low number of non-respondent forms, no statistical analysis was carried out and any comparison should be made cautiously. It is unlikely that the non-response had a significant effect on the distribution results of the present study, even if its size may have been underestimated to some extent for the reasons reported above.

In Denmark, the total number of seriously injured drivers for whom both a datasheet was received in DTU and a blood sample was received in UKBH was 856. In about 60 cases either a blood sample analysis or a patient data sheet was missing. Reasons for this could be: the patient datasheet showed that the person did not meet the criteria for inclusion, the tube for the blood sample was broken so the sample could not be analysed, the blood sample was considered not relevant and discarded in the hospital or simply that, for a specific DRUID bar code, either blood sample was not taken or the patient

[9] VALT= Finnish Motor Insurers' Center
[10] NIPH= Norwegian Institute of Public Health
[11] In some cases, screening results from urine haven been reported. This was only done when the screening gave a negative result and when there was not enough blood to conduct the analyses.
[12] Results from analyses on muscle tissue have also been reported in a few cases there was nog enough blood to conduct the analyses

datasheet was not submitted to DTU. However, it is unlikely that this has influenced the distribution of drivers in the study population.

The participation rate in the **Finnish** survey is more than 90%, no problems were reported. It is safe to assume that non-response does not have any confounding effect on the results.

In **Italy** the collection of patient information other than age, gender and medication in the hospital prior to sampling was difficult and not achieved in most of the cases; accident information from the police could not be obtained. No confounding effect due to non-responses in sampling injured drivers was observed.

During the **Lithuanian** hospital study no patients refused to participate. The response rate was 100%. No problems were reported.

No informed consent was needed to collect a blood sample from injured drivers in the **Netherlands**. Therefore, the risk of selection bias caused by this factor was non-existent. It is possible, however, that drug and alcohol intoxicated patients were less likely to be blood sampled than sober patients, e.g., because of aggressive behaviour or because of their entrance in the Emergency Departments during peak hours. Unfortunately, no information on this kind of non-response could be retrieved by the medical staff of the Emergency Departments.

Table 7. Problems encountered-injured drivers

INJURED DRIVERS	
Country	**Problems encountered**
Belgium	No blood sample was available for toxicological analysis in some cases For some drivers a patient form was filled in, but they refused to give a blood sample for toxicological analysis
Denmark	Blood sample or patient sheet went missing
Finland	No problems reported
Italy	Accident information from the police could not be obtained
Lithuania	No problems reported
Netherlands	Drug and alcohol intoxicated patients were less likely to be blood sampled than sober patients

2.1.4.2 Killed drivers : problems encountered

In **Finland** analytical toxicology results were either partially or completely missing for only a relatively small number of cases (37).

Norway received blood samples for analysis of alcohol and drugs from 59% of all drivers of cars and vans killed in Norway during the study period. It was expected that sampling was not performed if the police considered that the probability of finding alcohol or drugs was low, but other practical matters as economy and transportation over long distances to obtain an autopsy might also have contributed.

In **Portugal**, the cases of drivers killed in immediate fatal accidents in which analysis was performed only for alcohol or only for alcohol and illicit drugs were excluded from the study. This was done to permit a comparative analysis of the results obtained in other countries. Therefore the number of fatal road accidents that occurred in 2009 in Portugal is higher than the number of cases included in this study.

In **Sweden** additional analyses, besides the analyses performed by the National Board of Forensic Medicine, were carried out in order to cover the DRUID substances. This was possible in most cases but since the additional analyses were made afterwards, for a few drivers there was no blood sample left. Thus, there are missing values for some substances and drivers.

Table 8. Problems encountered – killed drivers

KILLED DRIVERS	
Country	**Problems encountered**
Finland	No problems reported
Norway	No analysis was done for following reasons - Probability of finding alcohol or drugs was low - Practical matters such as economy - Transportation over long distances to obtain an autopsy
Portugal	If analysis was performed for only alcohol or only for alcohol and illicit drugs, the case was excluded from the study
Sweden	Lack of blood sample to do extra analysis Missing values for some substances or drivers

2.2 Toxicology

2.2.1 Blood collection

A. Body fluid collection

It was decided to use whole blood or urine as matrix for the substance analyses.
Table 9 shows which country used which matrix.

Table 9. Body fluids used in DRUID WP 2

Country	Blood	Urine	Oral fluid	Muscle tissue
Injured drivers				
Belgium	X			
Denmark	X			
Finland	X		X	
Italy	X	X		
Lithuania	X			
Netherlands	X			
Killed drivers				
Finland	X			
Norway	X			
Portugal	X			
Sweden	X	X		X

B. Method of blood collection:

Summary:
- 5-10 mL whole blood collection in vacuum tubes containing sodium fluoride and potassium oxalate
- Transportation at 4°C (max 48 hours)
- Storage in laboratory at -20°C.

Sample collection for injured drivers study:
All laboratories analysing blood samples within WP2 performed analysis on whole blood. Blood was most commonly obtained from the median cubital vein on the anterior forearm. It could be drawn by venipuncture with vacuum tubes (tubes that contain a vacuum that aspirates blood into the tube.).
A tourniquet was placed on the arm where blood was to be collected. The vein to be used was palpated to determine its size, depth and direction. The skin was wiped with a disinfectant swab; an alcohol swab was not used due to possible contamination of the sample. The tourniquet was loosened or removed once blood started to enter the tube. A collection tube containing potassium oxalate and sodium fluoride (grey tops) were used. Blood collection tubes had to be filled completely to ensure that proper additive concentrations were maintained. The tubes were gently mixed by inverting 5 to 10 times immediately after collection to prevent coagulation.
All appropriate documents had to be filled in using the same identification number as used to label the collection tubes. Labelling had to be unambiguous.
If more than one container was taken from the same subject, these containers had to be identified with the same identification label, but the labels should specify how many containers were drawn from the same subject.

Storage and transportation
Data on the stability of commonly used illicit drugs are scattered over various publications, and a uniform study design had not been applied. The stability of drugs in blood was reviewed by Levine and Smith in 1990 (Forensic Science Reviews, 2:147-157) and Skopp and Pötsch in 2002 (Rechtsmedizin, 12: 195-202, in German). Since stability of even the most labile compounds (especially cocaine) had to be ensured, transportation measures had to be strict. Enzymatic degradation was slowed down by the presence of preservatives in the tubes. Chemical hydrolysis was decreased by low temperature during transportation. Therefore the blood samples had be transported cooled down or frozen.

Direct transportation of the samples to the laboratory was preferred. If this was impossible due to geographical reasons, samples could be shipped under specific conditions. Before shipping, national and international regulations had to be ascertained. Specimens had to be sent as diagnostic specimens and in two containers: the primary container had to be wrapped with Parafilm® or sealing tape around the lid, placed into a plastic bag or a screw cap container with enough absorbent material to absorb all of the fluid in the primary container, and be wrapped by a secondary container such as a cardboard box or mailing tube. This container had to prevent crushing of the specimen during transport.

Dry ice had to be placed between the plastic bag and the outer shipping container. It had to be shipped in insulated outer packaging, and could not be shipped in airtight container. Useful information and appropriate shipping containers were available from most contractors.

Upon arrival in the laboratory, samples had to be stored at -20°C.
Since the maximum time for storage at 4°C (= time between sampling and freezing) was 2 days, and transportation to the laboratory was not always easy to organise in some countries depending on the design of the studies (e.g. geographical situation, presence of dedicated personnel at the hospital,…) it was recommended to store samples frozen in the hospitals for e.g. one month and transport them to the laboratory in one shipment. During this transportation insulation and time were important, so that the samples were still frozen when they arrived at the laboratory since the consequences of multiple freeze-thaw cycles for the recovery of drugs in blood samples were unknown.

Sample collection for killed drivers study:

In general in the killed drivers study toxicological analyses were performed either on a post-mortem blood sample, or, for those cases in which the driver did not die immediately at the scene of the accident, on a blood sample taken from the driver shortly after the accident, or at the moment of hospital admission.

In the case of post-mortem samples, whenever possible, blood sample was taken from a peripheral site, typically the femoral vein, and collected in a glass or polyethylene test tube containing either sodium or potassium fluoride.

Sample collection in the killed drivers study could not always be done by a standardized method. This happened for two main reasons:

- post-mortem examination were carried out by institutions outside the DRUID-project.

- depending on the severity of the injuries and on the preservation of the body, a peripheral blood sample was not always available.

In the second case either the blood sample was collected not from a peripheral site and/or other specimens such as urine and muscle tissue were collected.

2.2.2 Toxicological analysis of blood and applied methods

Table 10 shows the analytical methods used by the WP2-hospital study partners. Extraction was based on liquid-liquid (LLE) or solid phase (SPE) extraction, chromatographic separation was performed by gas chromatography (GC) or liquid chromatography (LC): *High Performance (HPLC) or Ultra Performance (UPLC).* Detection was done by mass spectrometry (MS) or nitrogen/phosphorus detection (NPD).

Table 10. Analytical methods used in WP2

Country	Extraction	Chromatography	Detection
Belgium Blood:	SPE (LLE for THC)	UPLC (GC for THC)	MSMS (MS for THC)
Denmark Blood:	SPE (LLE for THC)	UPLC	MSMS
Finland Blood:	LLE,SPE	GC	MS
Italy Blood/Urine:	SPE +LLE (for THC)	HPLC (GC for THC)	MSMS (MS for THC)
Lithuania Blood:	LLE, SPE	GC	MS
Norway Blood	SPE or LLE or immobilised LLE or precipitation & evaporation	GC or HPLC or UPLC	MS or MSMS
Portugal Blood:	SPE	GC LC	MS MSMS
Sweden Blood:	LLE (Medications) LLE (THC and Amps) SPE (opiates, cocaine)	GC	NPD (Medications) MS (THC and Amps) MS (opiates, cocaine)
The Netherlands Blood:	PP	UPLC	MSMS

2.2.3 DRUID core and extra substances, cut-offs

A. Core substances

The following list of core substances (analysed for in all countries that participated in the hospital and killed driver study) as well as analytical cut-off values for analyses of blood were decided upon based on discussions between all partners. These were carried out by means of email and personal communication and the final decision was made at the WP2 meeting in January 2007.

Table 11. Core substances analysed in WP2

Substance	Whole blood analytical cut-off (ng/mL)
Ethanol	0.1 g/L
6-acetylmorphine	10
Alprazolam	10
Amphetamine	20
Benzoylecgonine	50
Clonazepam	10
Cocaine	10
Codeine	10
Diazepam	20
Flunitrazepam	2
Lorazepam	10
MDA	20
MDEA	20
MDMA	20
Methadone	10
Methamphetamine	20
Morphine	10
Nordiazepam	20
Oxazepam	50
THC	1
THCCOOH	5
Zolpidem	20
Zopiclone	10

B. Extra substances

Besides the core list, each country added a minimum of 3 extra substances for analysis, based on knowledge on distribution in the various countries and impairing effect on driving performance (e.g. based on pharmacological profile or previous studies).
Analytical cut-off values for analyses of blood were decided upon based on discussions between partners who analysed the same extra substances. These were carried out by means of email and personal communication. The final list was made in February 2010.

Table 12. Extra substances analysed

	FI	LT	DK	BE	PT	NO	NL	IT	SE		Cut-off (ng/mL)
	THL	TMI	DTU/ UKBH	UGent	CPS-NILM	FHI	SWOV/NFI	TFA-UNPD	VTI/ RMV	Total	Whole blood
Carisoprodol	1					1			1	**3**	500
Ketamine								1		**2**	20
Buprenorphine	1		1	1				1		**4**	1
Tramadol	1	1	1	1	1			1	1	**7**	50
7-a-clonazepam		1	1	1	1	1	1	1	1	**8**	10
Carbamazepine	1									**1**	NA
Olanzapine								1		**1**	10
Bromazepam			1	1				1		**3**	20
Meprobamate						1			1	**2**	2000
Chlordiazepoxide			1							**1**	20
7-a-flunitrazepam		1	1	1	1	1	1	1	1	**8**	2
Midazolam	1						1			**2**	10
Nitrazepam	1		1			1	1		1	**6**	10
7-a-nitrazepam			1			1	1		1	**4**	10
Temazepam	1						1			**2**	20
Amitryptiline	1			1				1		**3**	10
(Es)Citalopram	1			1						**2**	5
Fluoxetine	1							1		**2**	10
Mirtazapine	1			1						**3**	5
Trazodone				1						**1**	10
Venlafaxine								1		**1**	10
Levomepromazine	1									**1**	NA
Norbuprenorphine	1							1		**2**	2
11 OH-THC							1			**1**	1
Number of extra substances	13	3	8	9	3	6	7	11	7		

2.2.4 Drugs administered after the accident

The following medicinal drugs were possibly administered after the accident, before the (blood) sample was taken. These values were coded as -7. The concentration of these medicinal drugs was not taken into account for the calculation of prevalence.

Table 13. Drugs administered after the accident

Country	Medicinal drugs administered after the accident
Belgium	Morphine (26 cases), tramadol (25 cases), diazepam (11 cases), lorazepam (1 case)
Denmark	Morphine (4 cases), methadone (2 cases), diazepam (1 case)
Finland	Morphine (8 cases), tramadol (4 cases)
Italy	Morphine (15 cases)
Lithuania	Morphine (5 cases), Ketorolac (1case)
Norway	Morphine (1 case), Diazepam (6 cases)
Sweden	Morphine (6 cases)
The Netherlands	None

2.2.5 Proficiency tests

The institute that conducted proficiency testing (PrT) for blood samples was Arvecon GmbH, Germany.
Both qualitative and quantitative results were measured.
Qualitative results were evaluated using sensitivity (and specificity), Quantitative results were evaluated using the standard deviation according to Horwitz (SD_{HOR}). Z-scores were calculated using SD_{HOR}.

$$VC = 2^{(1-0,5\log C)}$$

VC = variation coefficient (%)

C = analyte concentration (kg/L)

$$z-score = \frac{result - target\ value}{SD_{HOR}}$$

A proficiency testing scheme was set up for the DRUID research project in which whole blood was analyzed by twelve laboratories. A common collection and analysis methodology was used: vacuum tubes containing sodium fluoride and potassium oxalate were used for collections and LC-MS/MS or GC-MS confirmation analysis of 25 substances (26 in the second round) containing both licit and illicit drugs is performed on all samples.

Four rounds of proficiency testing were organised between March 2008 and December 2009.
Whole blood samples were spiked with analytes and lyophilised at Arvecon.

Laboratories were instructed to first store the vials at room temperature for 30 min. After reconstitution with exactly 5.0 ml bidistilled (demineralised) water, the specimen had to be swirled gently and stored for 15 minutes at room temperature. Before sampling, the vial had to be inverted gently to ensure homogeneity. It was strongly recommended to prepare the sample material for the analysis of cocaine and zopiclone on the day of reconstitution.

Analytes were screened, identified and quantified using a mass spectroscopy-based technique. Samples were expected to be tested and electronically reported to Arvecon. Results were reported back to each participating lab anonymously, but with identification to the DRUID coordinator to allow the latter to make corrective actions.

Qualitative results were evaluated using sensitivity. Sensitivity is defined as the number of analytes correctly reported positive divided by the total number of analytes spiked in the samples.

In the first round of proficiency testing, most laboratories were still in the process of development and validation or had only recently completed this, and therefore lower scores were generally obtained. Both qualitative and quantitative performancey increased during the program. False negatives were mostly attributable to z-drugs and benzodiazepines.

2.3 Data analysis

For calculating prevalence, substances of the same type were combined into following substance groups: alcohol, amphetamines, cocaine/1, cocaine/2, cannabis/1, cannabis/2, illicit opiates, benzodiazepines, Z-drugs, and medicinal opioids.

Substance groups are aggregated into the following substance classes: alcohol, illicit drugs, medicinal drugs and following combinations: drug-alcohol and drug-drug. This last class is specified as a combination of different substance groups. For example: zolpidem + cocaine will be considered a drug-drug combination but zolpidem + zopiclone will be considered a single use of z-drugs.

Table 14. Substance classes, groups and the analytical findings

Type	No.	Group	Analytical findings
Alcohol	512	alcohol	ethanol
Illicit drugs	1	amphetamines	amphetamine methamphetamine or methamphetamine + amphetamine MDMA or MDMA + MDA MDEA or MDEA + MDA MDA
	2	cocaine/1	benzoylecgonine
	4	cocaine/2	cocaine + benzoylecgonine or cocaine
	8	cannabis/1	THCCOOH
	16	cannabis/2	THC or THC+THCCOOH
	32	illicit opiates	6-acetylmorphine or 6-AM + codeine or 6-AM + morphine or 6-AM + codeine + morphine or (morphine + codeine and morphine>= codeine)
Medicinal drugs	64	benzodiazepines	Diazepam or diazepam + nordiazepam or diaz + oxaz or diaz + nordiaz + oxaz nordiaz or nordiaz + oxaz oxazepam lorazepam alprazolam flunitrazepam or flunitrazepam + 7-aminoflunitrazepam clonazepam or clonazepam + 7-aminoclonazepam
	128	Z-drugs	zolpidem zopiclone
	256	medicinal opioids	morphine codeine or (codeine + morphine and codeine> morphine) methadone tramadol
Various combinations		drug-alcohol	
		drug-drug	

In order to calculate frequencies to describe the distribution of drivers (by age groups, gender, road type, etc.) statistical analysis were carried out using the software package SPSS, version 15 (renamed in IBM SPSS Statistics). Confidence interval (95%) for difference in proportions were calculated to determine the significance of the differences. Whisker and Box plots were made with the software program MedCalc.Percentages of positive findings were calculated using Microsoft Office Excel 2007.

2.4 Toxicological results - Data analysis

For the analysis of the toxicological findings, drugs have been grouped according to their pharmacological characteristics (2.3 Data analysis: Table 14), and a sample was considered positive if at least one drug was found at or above the DRUID cut-offs (2.2.3 DRUID core and extra substances, cut-offs: Tables 11-12).

In this chapter, data are analysed according to two criteria.

1) Prevalence of substance groups use among sampled drivers, calculated as

$$\frac{\text{Number of subjects positive for one specific substance group}}{\text{Number of subjects analysed for the presence of the same specific substance group}}$$

In this first analysis the same subject may appear under several substance groups, as a result of poly-drug use. The data give an indication of how many people use the different substance groups among the sampled subpopulations.

2) Distribution of positive drivers among sampled subjects, calculated as

$$\frac{\text{Number of subjects positive for one specific substance group}}{\text{Number of subjects analysed for all substance groups}}$$

In this second analysis, substance groups become mutually exclusive. A subject can be part of one group only, independently of the number of substances taken. When this principle is applied, only one out of two cases can occur: either the driver tested positive, as a consequence of single/combined psychoactive substance use, or he/she did not.

First data about prevalence of use are presented for the two studies separately (seriously injured drivers and killed drivers). Then distributions of positive drivers (Mutually exclusive groups) are presented for the seriously injured drivers study and for the killed drivers study.

2.4.1 Missing values

Toxicological analysis is sometimes incomplete for some of the drivers, in the sense that one subject may not have been screened for the presence of all drugs listed in the different substance groups. This can happen for two reasons:

1. Insufficient blood sample to carry out all toxicological analyses
2. Driver was given a specific drug in hospital before blood sampling (for example morphine for pain management). As a consequence, it is not anymore possible to establish if that specific drug was present in the blood sample before administration in hospital

In the above cases, it is not always possible to include the driver in a specific substance group. For example, these two cases may occur:

A. Subject analysed for alcohol only and found positive. No other toxicological analysis performed.
   Prevalence of substance groups use: the subject is included in the alcohol prevalence calculation, but cannot be considered for the other substance groups, because it is not possible to establish if any of the other drugs was also present in the blood sample
   Distribution of positive drivers: the driver tested positive, but it is not possible to allocate the subject to the "alcohol-only" or "alcohol-drug" group, because the sample was analysed only for alcohol presence (substance group unknown)
B. Subject analysed for all substance groups apart from alcohol. All negative findings.
   Prevalence of substance groups use: subject is included in all substance groups prevalence calculations, apart from alcohol because this value is missing
   Distribution of positive drivers: sample cannot be included, because the subject may have been positive for the presence of alcohol, but its presence/absence remains unknown

As a consequence of incomplete toxicological analysis, the number of subjects included in prevalence calculations can vary. Also, as drugs have been aggregated into groups, one single substance may have a significant impact on the number of samples excluded. This is for example the case of "benzodiazepines" and "medicinal opioids" groups, that are most affected, both as a result of including different drugs in the same group and as a result of drug administration before blood sampling.

The number of observations included in the calculation of each prevalence is reported at the beginning of the relative chapter.

Some countries did not screen for one specific drug in a substance group. To reduce the number of samples rejected and to account for these major differences, some deviations from the substance groups described in Table 14 in chapter 2.3 (Data analysis) had to be applied. These are listed here.
In both seriously injured and killed drivers studies.

- All countries – Samples were not rejected if MDEA screening was not carried out. This was done after considering that none among all analysed samples in all countries was positive for this amphetamine.

In the killed drivers study

- Norway and Finland – No sample was screened for the presence of THCCOOH: samples were not rejected, however prevalence of THCCOOH (Cannabis 1) use cannot be calculated and association of alcohol or other drugs with THCCOOH cannot be detected.
- Norway – No sample was screened for tramadol (this medication was not commonly prescribed in Norway during 2006-2008, when samples were collected): the "Medicinal opioids" group is reduced to "morphine, codeine, codeine+morphine (if codeine>morphine), methadone"
- Norway – Not all samples were screened for the presence of lorazepam (this medication is not available for prescription in Norway): the "Benzodiazepines" group is reduced to "diazepam, nordiazepam, oxazepam, alprazolam, flunitrazepam, clonazepam and various combinations".
- Portugal – No sample was screened for zopiclone presence (this medication is not available for prescription in Portugal): the "Z-drug" group is reduced to: "zolpidem".

2.4.2 Interpretation of toxicological findings

In the body cocaine and THC break down into benzoylecgonine and THCCOOH respectively. These two substances are not pharmacologically active. Although the active

substances may be still present in the brain, it is normally assumed that impairment cannot be demonstrated when benzoyleconine and/or THCCOOH are found alone in a blood sample, because it is not possible to establish unequivocally that the person was under the influence of cocaine and/or THC at the time the blood sample was taken.
In the present study, substances of the same type have been aggregated into substance groups, with the group “Cocaine 1” and “Cannabis 1” including respectively benzoylecgonine only (without cocaine) and THCCOOH only (without THC).
In the mutually exclusive groups (“Distribution of positive drivers”), substance groups in combination are aggregated into “alcohol-drug” or “drug-drug” classes. In this chapter, the combination of benzoylecgonine and/or THCCOOH with alcohol or another drug have been classified as “alcohol-drug” and “drug-drug” combinations respectively.

Cases of opiates use have been classified as illicit when one of the following findings were present: “6-acetylmorphine” or “morphine + codeine and morphine>= codeine” or their combinations, according to the description in part 2.3 (Data analysis: Table 14). However, concentration of 6-acetylmorphine and/or codeine, when present, were taken into consideration even when below the DRUID cut-off.

2.4.3 Prevalence of substance groups use among sampled drivers

The data give an indication of how many people use a specific substance groups among the sampled subpopulations.

In this analysis the same subject may appear under several substance groups, as a result of poly-drug use. Data are shown in the form of percentages in tables and graphs, and the prevalence is calculated as

$$\frac{\text{Number of subjects found positive for one specific substance group}}{\text{Number of subjects screened for the presence of the same specific substance group}} \times 100$$

In a first table the percentage of positive findings is reported for each substance group and for each country. In the corresponding bar graph, by means of different colours, a detail of the toxicological findings is given to distinguish subjects in which the substance group was found alone from those in which the substance group was found in combination.

In a second table details are shown about the use of the substance group by age and gender. When possible, for subjects of known age and gender, the data are also shown in the form of a graph.

Table 15 shows the number of subjects included in the “Prevalence of substance groups use” calculations for each country in the two studies.

Table 15. Number of subjects included in "Prevalence of substance groups use"

	Seriously injured drivers						Killed drivers			
Number of samples screened for specified substance group	**BE**	**DK**	**FI**	**IT**	**LT**	**NL**	**FI**	**NO**	**PT**	**SE**
Alcohol	348	838	53	676	385	186	471	193	285	153
Amphetamines	346	837	54	676	385	187	466	176	285	152
Benzoylecgonine (=Cocaine/1)	346	837	49	676	385	187	466	171	285	152
Cocaine (=Cocaine/2)	346	837	53	676	385	187	466	179	285	152
THCCOOH (=Cannabis/1)	344	836	53	676	385	187	0	0	285	147
THC (=Cannabis/2)	344	836	53	676	385	187	466	179	285	152
Illicit opiates	346	837	53	676	385	187	466	179	285	152
Benzodiazepines	342	835	49	676	385	187	466	176	285	154
Z-drugs	346	837	53	676	385	187	466	182	285	154
Medicinal opioids	332	835	50	676	385	187	466	177	285	146

2.5 Distribution of positive drivers – Mutually exclusive groups

This analysis is the one generally used to present data in the country reports.

The data give an overview of the number of drivers who tested positive for at least one of the studied substances.

Being the focus only on the presence/absence of a drug or combination of drugs, substance groups become mutually exclusive. This is because a subject can be part of one group only, independently of the number of substances taken: either the driver tested positive, as a consequence of single/combined psychoactive substance use, or he/she did not.

Data are shown in the form of percentage in tables and graphs, and the distribution of positive drivers is calculated as:

$$\frac{\text{Number of subjects positive for one specific substance group}}{\text{Number of subjects screened (for all substance groups)}} \times 100$$

When the toxicological analysis is incomplete and the exact substance group cannot be allocated, the sample is not included in the analysis. Once this first selection is made, prevalence calculation is always based on the same number of subjects. The number of samples included for each country in the "Distribution of positive drivers" calculations is shown in Table 16.

Table 16. Number of subjects included in "Distribution of positive drivers"

	Seriously injured drivers						Killed drivers			
	BE	**DK**	**FI**	**IT**	**LT**	**NL**	**FI**	**NO**	**PT**	**SE**
Group of appurtenance known ("toxicological screening complete")	325	831	47	676	385	186	459	165	285	141

Table 17 shows the total number of subject excluded from the "Distribution of positive drivers" calculations. Although some of these drivers tested positive, the substance group cannot be allocated, because of incomplete toxicological analysis.

Table 17. Number of subjects excluded from "Distribution of positive drivers"

	Seriously injured drivers						Killed drivers			
	BE	**DK**	**FI**	**IT**	**LT**	**NL**	**FI**	**NO**	**PT**	**SE**
Toxicological screening incomplete and all negative findings	13	6	6	0	2	1	19	21	0	13
Positive toxicological finding, but substance group appurtenance unknown*	10	3	1	0	0	0	5	7	0	3
Total	23	9	7	0	2	1	24	28	0	16

*Two possible cases: either "positive alcohol finding + missing analysis for drug groups" or "alcohol analysis missing + positive drug groups finding".

Distributions of positive drivers among different age and gender groups are reported, as well as distributions of positive drivers during different time periods (week/weekend, day/nights) and in different type of accident (single- and multiple-vehicle).

3 Results

3.1 Introduction

This chapter gives a general overview of substance distribution, and outlines similarities and differences between findings in seriously injured and/or killed drivers in the 9 countries involved. Among all subjects sampled, a selection was made to obtain relatively similar subpopulations of seriously injured and killed drivers. The analysis focuses on the drivers of passenger cars and vans.

Specific details about other type of drivers (of motorcycles, bicycles, lorries, etc.) can be found in the respective country reports, together with descriptions of different distributions (age, gender, time of accident, etc.) and toxicological findings.

3.2 Inclusion criteria

Guidelines for the study and the data collection, described in Annex 1, were used as a starting point to select the sub-populations. In particular, in the case of seriously injured drivers, subjects were selected on the basis of the following obligatory inclusion criteria:

- Driver of a motorised vehicle (passenger car or van)
- Time interval between accident and sampling less than 3 hours
- Severity of injuries: MAIS (Maximum Abbreviated Injury Scale) 2 or higher, or drivers selected on the basis of national criteria that ensured severity of injuries in the range of MAIS score 2 or above

Subjects aged below 18 and subjects not fulfilling the above criteria were also excluded. After considering the overall distribution of samples in the different databases from the participating countries, it was decided to include also subjects for whom one of the above variables was unknown.
The criteria applied for the selection of the sub-populations analysed in this chapter were generally stricter than the ones applied in the single country reports. For this reason the number of subjects included are generally smaller than in the country reports. Table 18 shows the number of samples left for each participating country after applying the listed selection criteria.

Table 18. Seriously injured drivers study. Sub-populations sample selection

Country	Total number of subjects in the country database	Cars & Vans or unknown	Time between accident and sampling <3 hours or unknown	MAIS ≥ 2 or equivalent or unknown	Age 18 and above or unknown	Number of subjects in the selected sub-populations
BE	1078	377	349	348	348	348
DK	856	856	844	844*	840	840
FIN	325	209	170	54	54	54
IT	690	690	682	682*	676	676
LT	424	389	388	387	387	387
NL	197	195	188	188	187	187
TOTAL	3570	2716	2621	2503	2492	**2492**

* MAIS score was not available in Denmark and Italy and the two countries applied different inclusion criteria. In particular, in Denmark, inclusion criteria were based on Danish trauma score, while in Italy only subjects given a prognosis of 20 days or longer were included in the study. These criteria are considered to guarantee inclusion of patients with injury severity equivalent to MAIS score 2 or higher.

"Time between accident and blood sampling" and "MAIS score" caused the most exclusions. The majority of car/van drivers sampled in Finland had a MAIS lower than 2 and had to be excluded.
The percentage of samples that cannot be included in the selected sub-populations, because they did not fulfil the inclusion criteria, ranged between 1.9% (Denmark) and 74.2% (Finland).

Table 19 shows the number of subjects included in the sub-populations from the killed drivers study. Drivers of car and vans, aged 18 and above, were selected together with subjects for which one of these variables was unknown. Time between accident and death was not considered. When recorded, the survival time ranged from 0 (immediate death) to just below 24 hours.

Table 19. Killed drivers study. Sub-populations sample selection

Country	Total number of subjects in the country database	Car & van drivers or unknown	Age 18 and above or unknown	Number of subjects in the selected sub-populations
FIN	652	483	483	483
NO	193	193	193	193
PT	290	290*	285	285
SE	158	158	157	157
TOTAL	1293	1124	1118	**1118**

*In Portugal information about type of vehicle could not be gathered, as data are stored in the police database, to which the Portuguese National Institute of Legal Medicine has no access. However, distribution of type of vehicles among killed drivers is expected to be similar to the one in the roadside survey, that showed a high prevalence of cars and a very low prevalence of other type of vehicles, with motorcycles and trucks accounting only for approximately 2% of the population.

Samples collected in Finland and Norway fulfilled all inclusion criteria. In the Swedish database one subject was excluded being younger than 18 years. For the same reason 5 subjects were excluded in the Portuguese database.

General data about the selected subpopulations are described in this chapter separately first for the seriously injured drivers study and then for the killed drivers study. Discussion is done on two levels. First a description of the sampled subpopulations is presented, while in a second part the toxicological findings are reported.

3.3 Seriously injured drivers (C&V) - Description of the driver sample

3.3.1 Distribution over the countries/regions

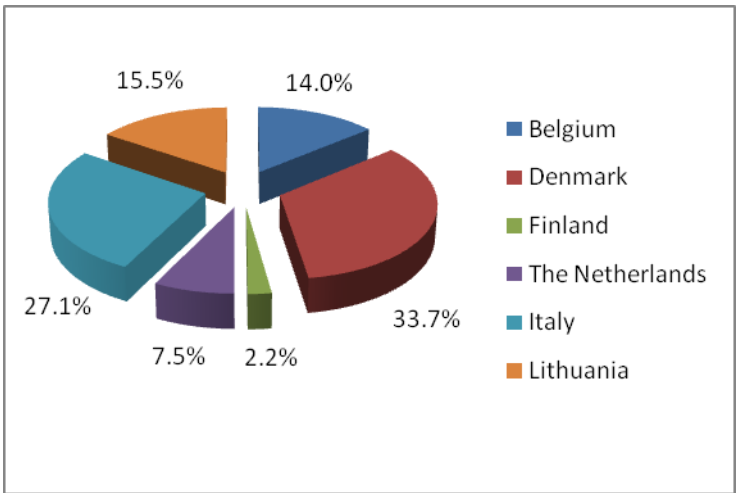


Figure 2. Distribution of study population by country

The highest number of injured drivers (C&V) was sampled in Denmark (33.7%), followed by Italy (27.1%).

3.3.2 Distribution by road type

Since in Belgium the classification urban-rural was not available, two categories were added for this country.
39.1% of drivers were sampled on an unknown road type, with the highest numbers for Italy and The Netherlands because for those countries no data on road type was available.
Disregarding the Belgian data for speed limit up to or above 90 km/h, 26.5% of drivers were sampled on urban roads, 29.2% on rural roads and 44.3% on unknown type of road.

Table 20. Distribution by country and road type

Type of road	Country						Total
	Belgium	Denmark	Finland	Italy	Lithuania	The Netherlands	
Urban road	0	191 (22.7%)	13 (24.1%)	0	380 (98.2%)	0	584
Rural road	0	606 (72.1%)	33 (61.1%)	0	5 (1.3%)	0	644
Up to 90 km/h	208 (59.8%)	0	0	0	0	0	208
Above 90 km/h	81 (23.3%)	0	0	0	0	0	81
Unknown	59 (17.0%)	43 (5.1%)	8 (14.8%)	676 (100%)	2 (0.5%)	187 (100%)	975
Total	348 (100%)	840 (100%)	54 (100%)	676 (100%)	387 (100%)	187 (100%)	**2492**

By selecting only cases with urban, rural or unknown road type, significant differences were found between the countries (p<0.01). Both Denmark and Finland have more drivers injured on rural roads, this is in contrast to Lithuania, where there were more injured drivers on urban roads. The proportion of unknown road type was less in Lithuania and Denmark compared to Belgium and Finland.

3.3.3 Distribution by day of the week and time of the day

The time periods (see annex1) have been aggregated into Weekday (time periods 1+2+3), Week night (time period 4), Weekend day (time periods 5+6+7) and Weekend night (time period 8).

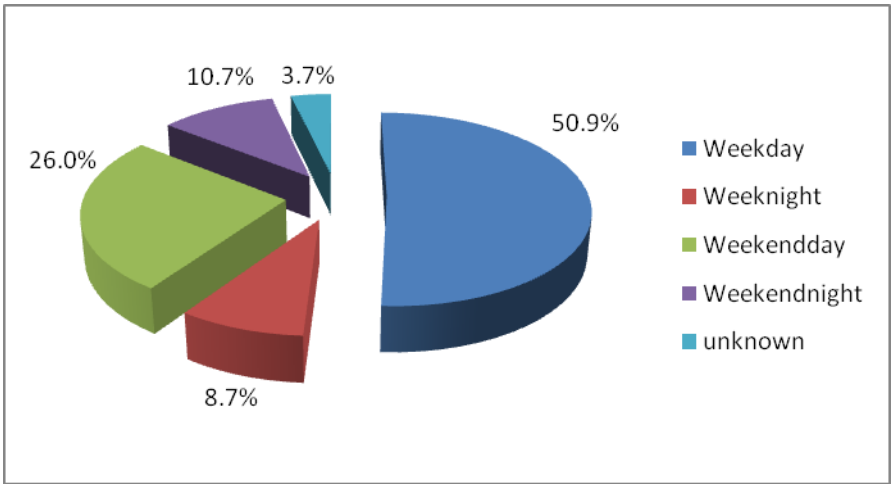


Figure 3. General distribution of the study population by time of the day and day of the week

76.9% of the accidents occurred during daytime (50.9% on a weekday, 26% in weekends). 8.7% and 10.7% on week nights and weekend night accidents respectively.
This trend was seen in all countries except for the Netherlands where week night accidents occurred more and weekend day accidents less.

Table 21. Distribution by country and time of the week

Time period	Country						Total
	Belgium	Denmark	Finland	Italy	Lithuania	The Netherlands	
Weekday	146(42.0%)	503(59.9%)	24(44.4%)	264(39.2%)	241(62.3%)	90(48.1%)	1268
Weeknight	45(12.9%)	39(4.6%)	5(9.3%)	71(10.5%)	11(2.8%)	46(24.6%)	217
Weekend day	96(27.5%)	212(25.2%)	19(35.2%)	214(31.6%)	85(22.0%)	23(12.3%)	649
Weekend night	52(14.9%)	68(8.1%)	6(11.1%)	89(13.2%)	24(6.2%)	28(15.0%)	267
unknown	9(2.6%)	18(2.1%)	0	38(5.6%)	26(6.7%)	0	91
Total	348(100%)	840(100%)	54(100%)	676(100%)	387(100%)	187(100%)	**2492**

Disregarding the unknown and the Finnish data, a significant difference was found between the countries (p<0.01).
There are more weekday accidents in Denmark and Lithuania. For week- and weekend-night accidents a lower proportion was found in these countries.

3.3.4 Distribution by quarter of the year

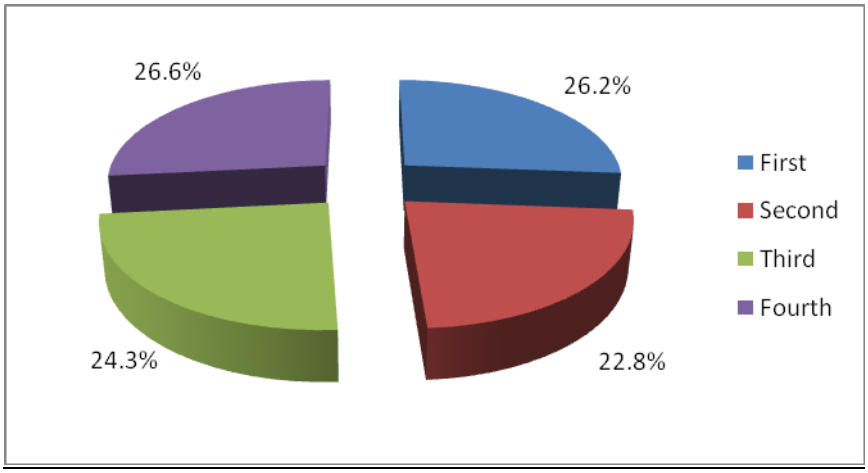


Figure 4. General distribution of the study population by quarter of the year

52.7% of the injured drivers were sampled in the first and fourth quarter of the year (26.2% and 26.5% respectively). The second quarter accounts for 22.8%, the third for 24.3%.

Table 22. Distribution by country and quarter of the year

quarter	Country						Total
	Belgium	Denmark	Finland	Italy	Lithuania	The Netherlands	
First	86(24.7%)	265(31.5%)	7(13.0%)	129(19.1%)	114(16.9%)	53(28.3%)	654
Second	69(19.8%)	139(16.5%)	11(20.4%)	223(33.0%)	81(12.0%)	46(24.6%)	569
Third	88(25.3%)	156(18.6%)	23(42.6%)	224(33.1%)	79(11.7%)	36(19.3%)	606
Fourth	104(29.9%)	280(33.3%)	13(24.1%)	100(14.8%)	113(16.7%)	52(27.8%)	662
unknown	1(0.3%)	0	0	0	0	0	1
Total	348(100%)	840(100%)	54(100%)	676(100%)	387(100%)	187(100%)	**2492**

This figures might be misleading because of different sampling periods between the countries as shown in table 23. Taking this sampling periods into account, different proportions were calculated, shown in table 24

Table 23. Distribution of sampling period by country

Country	Sampling period
Belgium	24 January 2008 – 2 May 2010
Denmark	1 October 2007 – 6 April 2010
Finland	26 April 2008 – 28 April 2010
Italy	25 February 2008 – 26 October 2009
Lithuania	22 April 2008 – 20 March 2010
The Netherlands	1 March 2008 – 30 April 2010

Table 24. Distribution by country and quarter of the year weighted for the sampling period accounting for one year

Quarter	Country						Total
	Belgium	Denmark	Finland	Italy	Lithuania	The Netherlands	
First	19.93%	26.95%	13.01%	23.41%	29.98%	26.33%	25.01%
Second	18.74%	20.60%	20.07%	28.33%	22.61%	23.00%	23.41%
Third	28.11%	23.88%	42.75%	28.45%	19.51%	20.96%	24.52%
Fourth	33.22%	28.57%	24.16%	19.81%	27.90%	29.70%	26.15%

Differences were seen in the second and fourth quarter. For Italy there was a higher proportion in the second quarter and a lower one in the fourth quarter compared to other countries. Finnish data are disregarded because of the low number of samples.

3.3.5 Distribution by age and gender

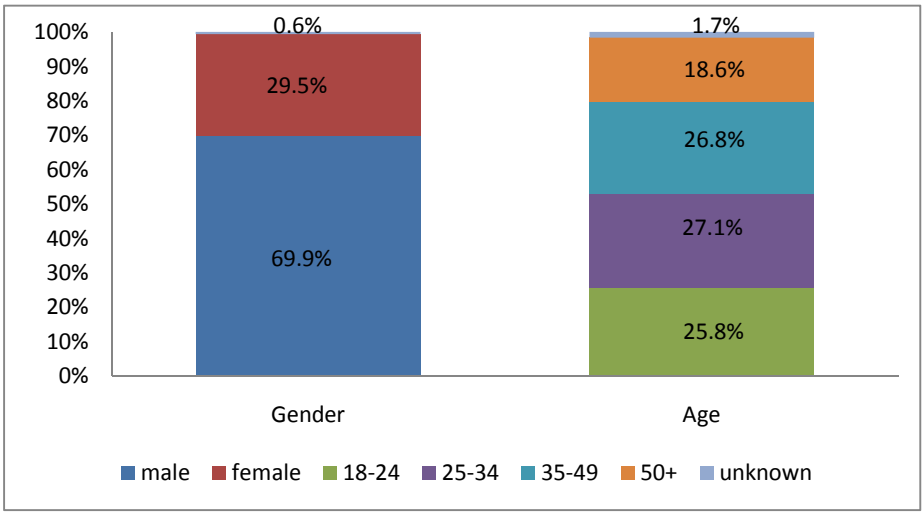


Figure 5. General distribution of the study population by age and by gender

Males accounted for 69.9%, females for 29.5%. 79.7% of the study population had an age between 18 and 49.

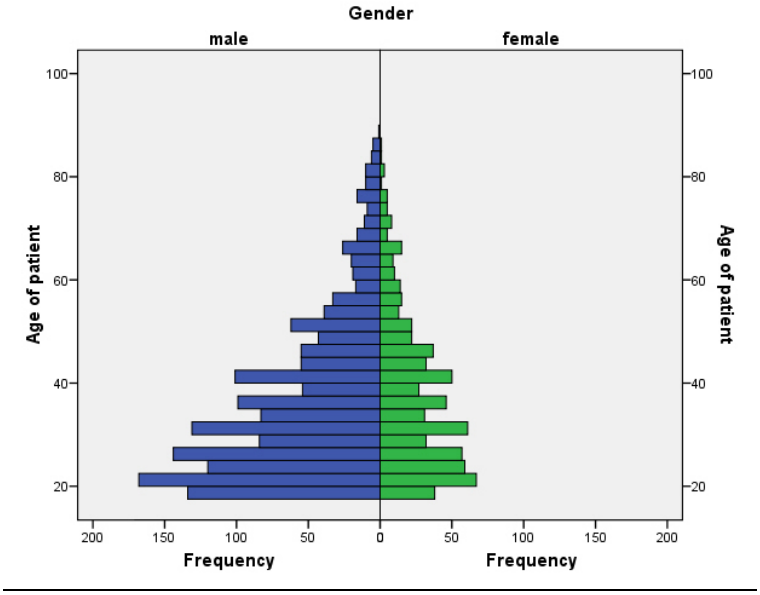


Figure 6. Histogram of the study population by age and gender

Table 25. Distribution by country, age and gender.

Gender	Age	Country						Total
		Belgium	Denmark	Finland	Italy	Lithuania	The Netherlands	
Male	18-24	53(21.8%)	188(34.4%)	14(32.6%)	100(19.2%)	67(28.0%)	50(33.3%)	472(27.1%)
	25-34	78(32.1%)	141(25.8%)	10(23.3%)	161(31.0%)	52(21.8%)	39(26.0%)	481(27.6%)
	35-49	56(23.0%)	127(23.2%)	9(20.9%)	149(28.7%)	66(27.6%)	35(23.3%)	442(25.4%)
	50+	48(19.8%)	90(16.5%)	10(23.3%)	110(21.2%)	42(17.6%)	26(17.3%)	326(18.7%)
	unknown	8(3.3%)	1(0.2%)	0	0	12(5.0%)	0	21(1.2%)
	Total	243(100%)	547(100%)	43(100%)	520(100%)	239(100%)	150(100%)	**1742**
Female	18-24	18(17.3%)	81(27.6%)	3(27.3%)	26(16.7%)	36(23.1%)	5(13.5%)	169(23.0%)
	25-34	28(26.9%)	63(21.5%)	1(9.1%)	47(30.1%)	42(26.9%)	12(32.4%)	193(26.2%)
	35-49	32(30.8%)	88(30.0%)	1(9.1%)	55(35.3%)	38(24.4%)	11(29.7%)	225(30.6%)
	50+	22(21.2%)	56(19.1%)	6(54.5%)	28(17.9%)	15(9.6%)	9(24.3%)	136(18.5%)
	unknown	4(3.8%)	5(1.7%)	0	0	4(2.6%)	0	13(1.8%)
	Total	104(100%)	293(100%)	11(100%)	156(100%)	135(100%)	37(100%)	**736**
Unknown	18-24	0				2(15.4%)		2(14.3%)
	25-34	0				2(15.4%)		2(14.3%)
	50+	0				1(7.7%)		1(7.1%)
	unknown	1(100%)				8(61.5%)		9(64.3%)
	Total	1(100%)				13(100%)		**14**

Significant differences were found for both gender and age groups ($p<0.01$) between the countries. There were more males in The Netherlands and Italy than in the other countries. For the age distribution, differences were found for the age group 18-24, which was less present in Belgium and Italy, and for the group 25-34, for which a higher proportion was seen in Italy, compared to the other countries. There were slightly more males in the age group 18-24, which could be attributed to the higher proportions in

Denmark and The Netherlands. More females were present in the group 35-49 which was mostly seen in Denmark.

3.3.6 Distribution by safety belt use

Table 26. Distribution of safety belt use

Safety belt use		Country						Total
		Belgium	Denmark	Finland	Italy	Lithuania	The Netherlands	
	Yes	215(61.8%)	0	0	0	0	106(56.7%)	321(12.9%)
	No	86(24.7%)	0	0	0	0	37(19.8%)	123(4.9%)
	Unknown	47(13.5%)	840(100%)	54(100%)	676(100%)	387(100%)	44(23.5%)	2048(82.2%)
Total		348(100%)	840(100%)	54(100%)	676(100%)	387(100%)	187(100%)	**2492**

In the injured drivers population, use of safety belt was unknown for 82.2% of the sampled drivers. This high percentage can be explained by the fact that only Belgium and the Netherlands gathered this type of information. If this is taken into consideration, out of the 535 drivers in Belgium and the Netherlands, 60% used a safety belt, 23% did not and for 17% data remained unknown. Since only Belgium and The Netherlands have data on the safety belt use, only these two countries were compared. A significant difference was found (p=0.011) due to the higher number of unknown in The Netherlands compared to Belgium. When only subjects for which safety belt use was known were taken into consideration, no difference found between the two countries (p= 0.553).

3.3.7 Distribution by type of vehicle

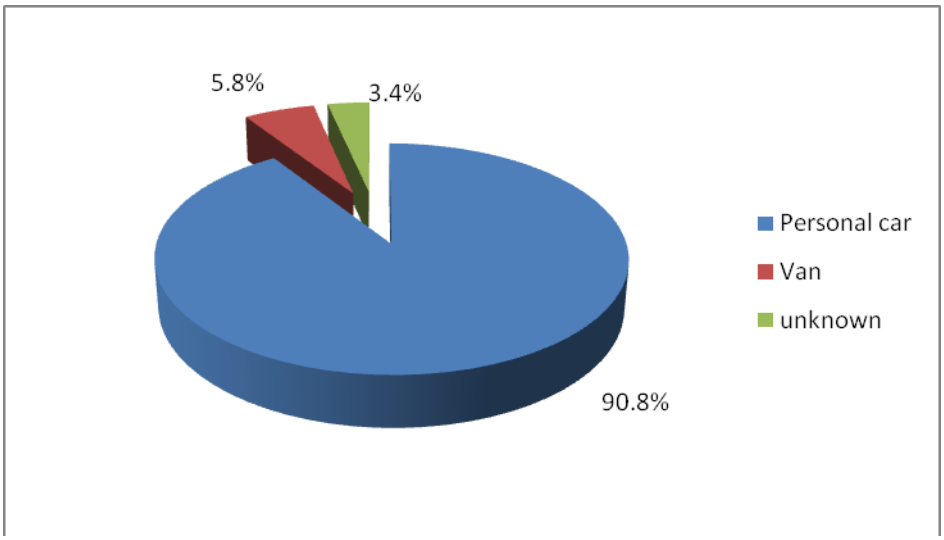


Figure 7. General distribution of the study population by vehicle type

Overall 90.8% of the study population was driving a personal car and 5.8% a small van.

Table 27. Distribution by country and type of vehicle

Type of vehicle		Country						Total
		Belgium	Denmark	Finland	Italy	Lithuania	The Netherlands	
	Personal car	324(93.1%)	789(93.9%)	51(94.4%)	577(85.4%)	346(89.4%)	176(94.1%)	2263
	Van	24(6.9%)	42(5.0%)	3(5.6%)	38(5.6%)	27(7.0%)	11(5.9%)	145
	Unknown	0	9(1.2%)	0	61(0.9%)	14(3.6%)	0	84
Total		348(100%)	840(100%)	54(100%)	676(100%)	387(100%)	187(100%)	**2492**

Disregarding the unknown and Finnish data (because of the low number of cases) no significant difference was found between the other five countries (p= 0.0583).

3.3.8 Distribution by accident type

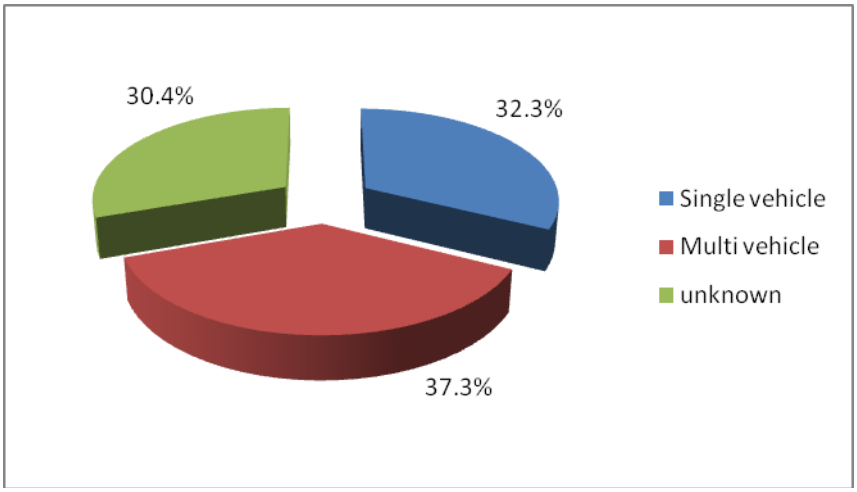


Figure 8. General distribution of the study population by accident type

Regarding the whole study population, 32.3% was involved in a single-vehicle accident and 37.3% in a multi-vehicle collision. For 30.4% accident data were unknown. This high percentage of unknown is due to the fact that Italy did not collect data on this variable. Taking only into consideration samples for which data about type of accident was known, out of the 1734 drivers, 46.4% and 53.6% were involved respectively in a single- and in a multi-vehicle accident.

Table 28. Distribution of study population by type of accident

Type of accident		Country						Total
		Belgium	Denmark	Finland	Italy	Lithuania	The Netherlands	
	Single vehicle	158(45.4%)	411(48.9%)	25(46.3%)	0	110(28.4%)	101(54.0%)	805
	Multi vehicle	165(47.4%)	415(49.4%)	26(48.1%)	0	263(68.0%)	60(32.1%)	929
	Unknown	25(7.2%)	14(1.7%)	3(5.6%)	676(100%)	14(3.6%)	26(14.0%)	758
Total		348(100%)	840(100%)	54(100%)	676(100%)	387(100%)	187(100%)	**2492**

Disregarding the unknown data, a significant difference was found (p<0.01).

There were more single-vehicle accidents in the Netherlands and more multi-vehicle accidents in Lithuania.

3.3.9 Distribution by injury severity

In Denmark and Italy, MAIS scores were not available, but drivers were selected on the basis of different criteria that ensured that the severity of injuries was in the range of MAIS score 2 or above. For these countries the variable code 'equivalent' was constructed.

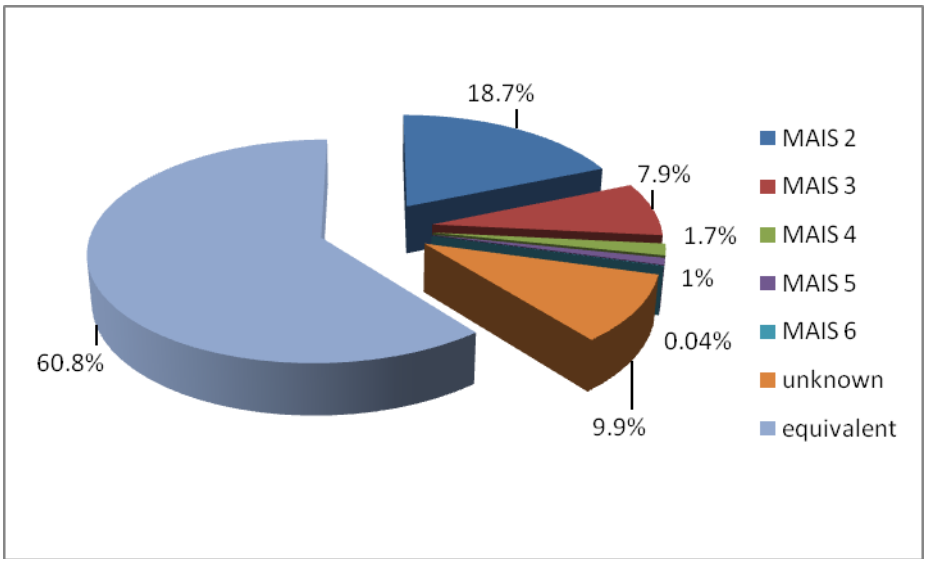


Figure 9. General distribution of the study population by severity of injuries

60.8% of the population was sampled in Denmark and Italy. For this reason the code 'equivalent' has the highest percentage, followed by MAIS 2 and unknown.

Table 29. Distribution of study population by injury severity

MAIS score	Country						Total
	Belgium	Denmark	Finland	Italy	Lithuania	The Netherlands	
2	208(59.8%)	0	30(55.6%)	0	136(35.1%)	91(48.7%)	465
3	97(27.9%)	0	21(38.9%)	0	12(3.1%)	66(35.3%)	196
4	20(5.7%)	0	2(3.7%)	0	4(1.0%)	16(8.6%)	42
5	12(3.4%)	0	0	0	1(0.3%)	13(7.0%)	26
6	0	0	0	0	1(0.3%)	0	1
Unknown	11(3.2%)	0	1(1.9%)	0	233(60.2%)	1(0.5%)	246
Equivalent	0	840(100%)	0	676(100%)	0	0	1516
Total	348(100%)	840(100%)	54(100%)	676(100%)	387(100%)	187(100%)	**2492**

Regarding the most prevalent MAIS scores (2 and 3) a significant difference was found ($p < 0.01$).The high number of unknown MAIS scores in Lithuania had the greatest influence on the unequal distribution. Because of the low number of samples per score, comparison with Finland was disregarded. Comparing Belgium and the Netherlands, there was an equal distribution for MAIS scores 3 to 5 and a higher proportion in Belgium for MAIS 2.

3.4 Killed drivers - Description of the driver sample

3.4.1 Distribution by country

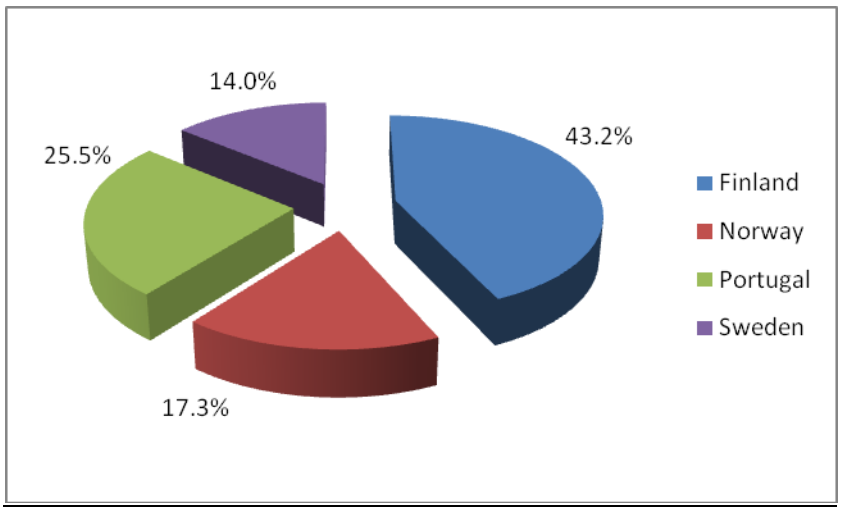


Figure 10. Distribution of study population by country

The highest number of killed drivers was sampled in Finland (43.2%), followed by Portugal (25.5%).

3.4.2 Distribution by road type

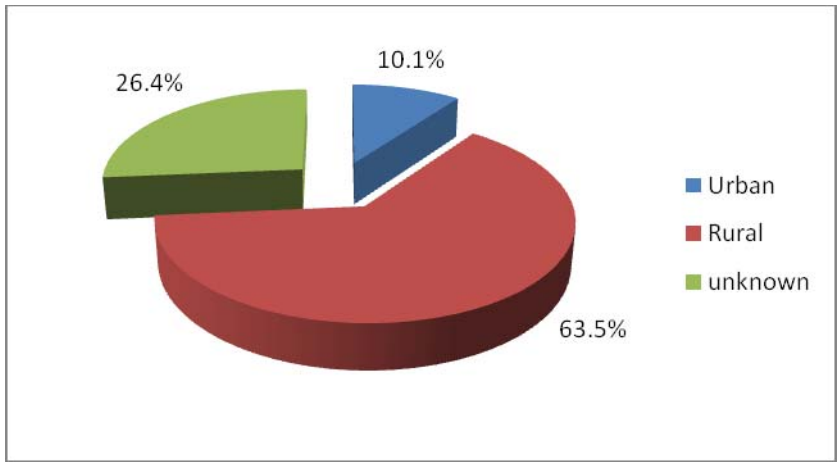


Figure 11. General distribution of the study population by road type

63.5% of the population was sampled on rural roads, 10.1% on urban roads. The high number of unknown is due to the fact that Portugal was unable to gather data on road type. Disregarding Portugal, the proportion of unknown data decreased to 1.2%. Of the 833 samples left, 13.5% and 85.2% were sampled respectively on urban and rural roads.

Table 30. Distribution by country and type of road

Type of road	Country				Total
	Finland	Norway	Portugal	Sweden	
Urban road	64(13.3%)	26(13.5%)	0	23(14.6%)	113(10.1%)
Rural road	409(84.7%)	167(86.5%)	0	134(85.4%)	710(63.5%)
Unknown	10(2.1%)	0	285(100%)	0	295(26.4%)
Total	483(100%)	193(100%)	285(100%)	157(100%)	**1118**

By selecting only cases with urban or rural road type, no significant difference was found between the countries (p=0.933)

3.4.3 Distribution by day of the week and time of the day

The time periods (see annex1) have been aggregated into Weekday (time periods 1+2+3), Weeknight (time period 4), Weekend day (time periods 5+6+7) and Weekend night (time period 8).

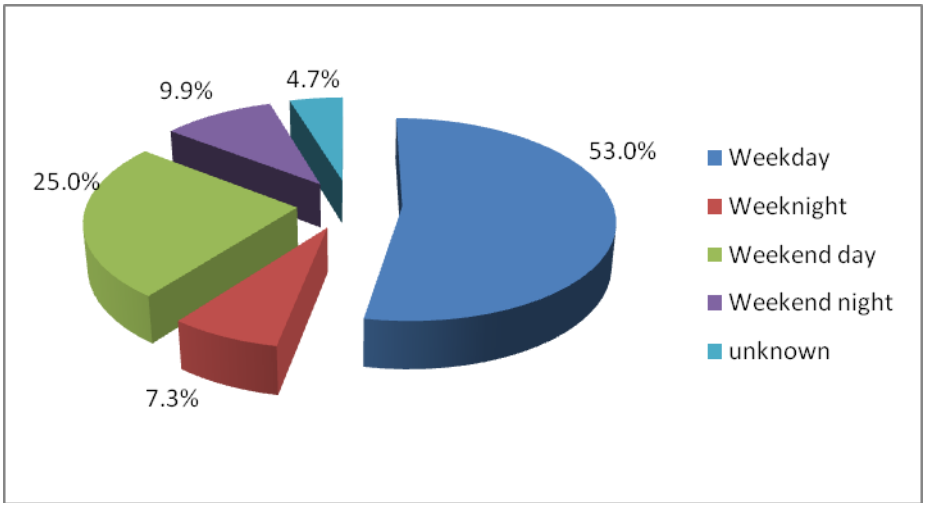


Figure 12. General distribution of the study population by time of the day and day of the week

78% of the accidents occurred during daytime (53% on a weekday, 25% in weekends). 7.3% and 9.9% were the percentage of accidents occured respectively during week night and weekend night.

Table 31. Distribution by country and time of the week

Time period	Country				Total
	Finland	Norway	Portugal	Sweden	
Weekday	270(55.9%)	112(58.0%)	114(40.0%)	97(61.8%)	593(53.0%)
Weeknight	41(8.5%)	10(5.2%)	24(8.4%)	7(4.5%)	82(7.3%)
Weekend day	122(25.3%)	52(26.9%)	69(24.2%)	36(22.9%)	279(25.0%)
Weekend night	50(10.4%)	19(9.8%)	25(8.8%)	17(10.8%)	111(9.9%)
unknown	0	0	53(18.6%)	0	53(4.7%)
Total	483(100%)	193(100%)	285(100%)	157(100%)	**1118**

Disregarding the unknown data, no significant difference was found between the countries (p= 0.254).

3.4.4 Distribution by quarter of the year

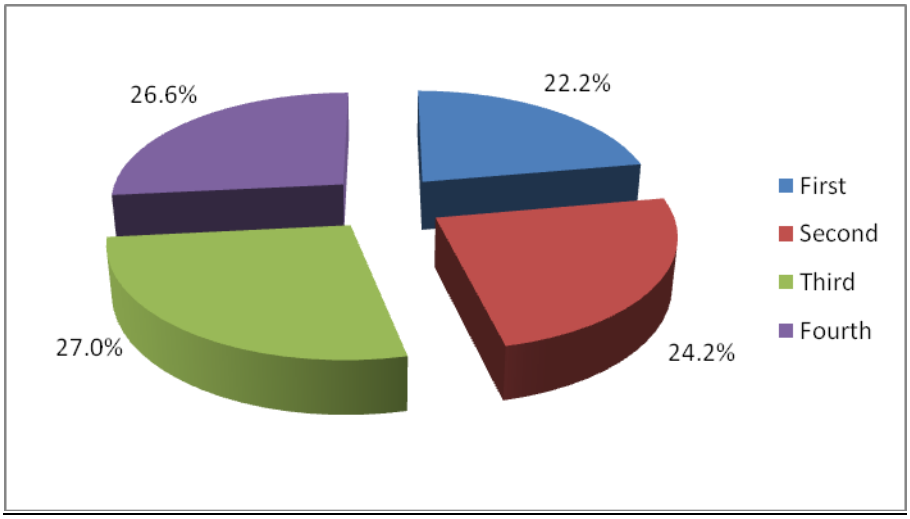


Figure 13. General distribution of the study population by quarter of the year

The highest proportion was found for the third quarter (27%), followed by the fourth (26.6%). 46.4% of the population was sampled in the first half of the year.

Table 32. Distribution by country and quarter of the year

Time period	Country				Total
	Finland	Norway	Portugal	Sweden	
First	104(21.5%)	41(21.2%)	62(21.8%)	41(26.1%)	248(22.2%)
Second	120(24.8%)	44(22.8%)	69(24.2%)	38(24.2%)	271(24.2%)
Third	123(25.5%)	49(25.4%)	86(30.2%)	44(28.0%)	302(27.0%)
Fourth	136(28.2%)	59(30.6%)	68(23.9%)	34(21.7%)	297(26.6%)
Total	483(100%)	193(100%)	285(100%)	157(100%)	**1118**

The distribution by quarter of the year was equal between all countries, no significant difference was found (p = 0.628).
This figures might be misleading because of different sampling periods between the countries as shown in table 33. Taking this sampling periods into account, similar proportions were calculated, (table 34) assuming no significant difference.

Table 33. Distribution of sampling period by country

Country	Sampling period
Finland	2 January 2006 – 29 December 2008
Norway	2 January 2006 – 25 December 2008
Portugal	5 December 2008– 19 December 2009
Sweden	1 January 2008 – 31 December 2008

Table 34. Distribution by country and quarter of the year weighted for the sampling period accounting for one year

Quarter	Country			
	Finland	Norway	Portugal	Sweden
First	21.49%	21.11%	22.51%	26.33%
Second	24.79%	22.65%	25.05%	24.13%
Third	25.41%	25.21%	31.22%	27.94%
Fourth	28.30%	31.03%	21.23%	21.59%

3.4.5 Distribution by age and gender

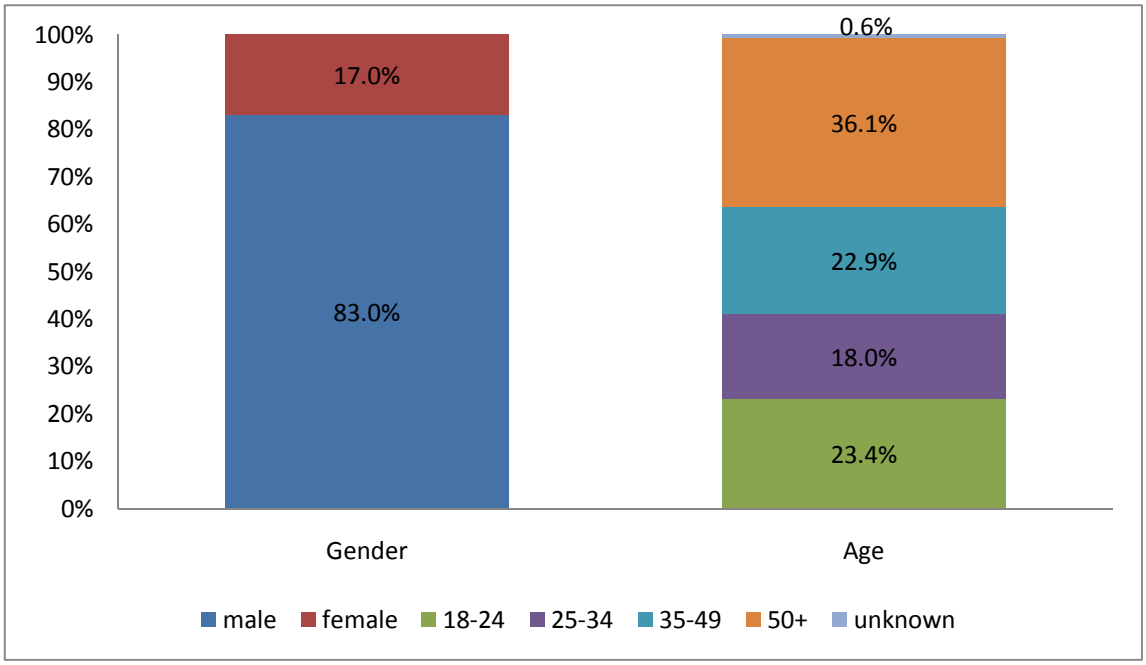


Figure 14. General distribution of study population of killed drivers by age and gender

Males accounted for 83%. No unknown data for gender were found. As for age groups the highest proportion was found for the group 50+.

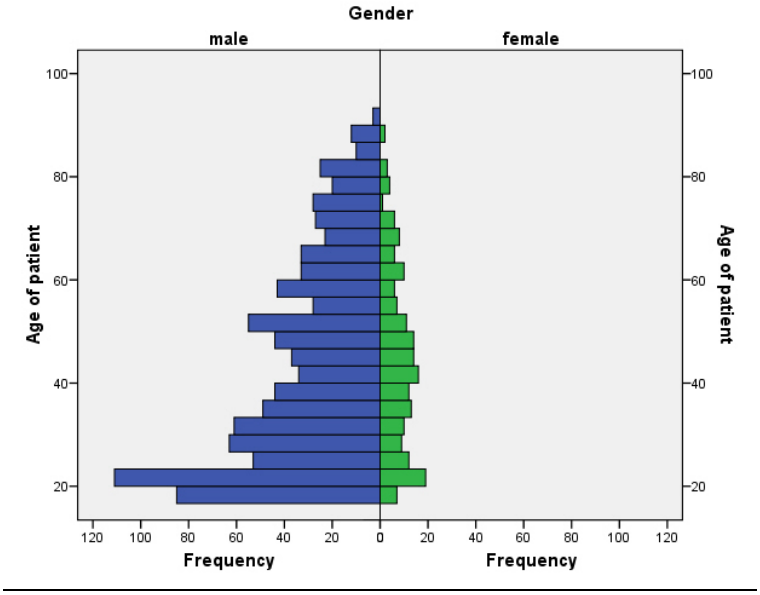


Figure 15. Histogram of the study population by age and gender

Table 35. Distribution by country, age and gender

Gender	Age	Country				Total
		Finland	Norway	Portugal	Sweden	
Male	18-24	99(25.3%)	48(31.6%)	41(15.5%)	30(25.2%)	218(23.5%)
	25-34	64(16.3%)	29(19.1%)	65(24.5%)	14(11.8%)	172(18.5%)
	35-49	70(17.9%)	29(19.1%)	69(26.0%)	23(19.3%)	191(20.6%)
	50+	159(40.6%)	46(30.3%)	83(31.3%)	52(43.7%)	340(36.6%)
	Unknown	0	0	7(2.6%)	0	7(0.8%)
	Total	392(100%)	152(100%)	265(100%)	119(100%)	**928**
Female	18-24	16(17.6%)	8(19.5%)	4(20.0%)	4(10.5%)	32(16.8%)
	25-34	10(11.0%)	8(19.5%)	6(30.0%)	5(13.2%)	29(15.3%)
	35-49	32(35.2%)	13(31.7%)	8(40.0%)	12(31.6%)	65(34.2%)
	50+	33(36.3%)	12(29.3%)	2(10.0%)	17(44.7%)	64(33.7%)
	Total	91(100%)	41(100%)	20	38(100%)	**190**

Significant differences were found for both gender and age groups ($p < 0.01$).
There were more males in Portugal compared to the other countries. For the age distribution, differences were found for the age group 18-24, which was less present in Portugal, this was in contrast to the age group 25-34. Subjects of the age group 50+ were more often found in Finland and Sweden than in the other countries. There were more males than females in the age group 18-24, which could be attributed to a higher proportion in Sweden. More females were found in the age group 35-49, because of a higher proportion in Finland.

3.4.6 Distribution by type of vehicle

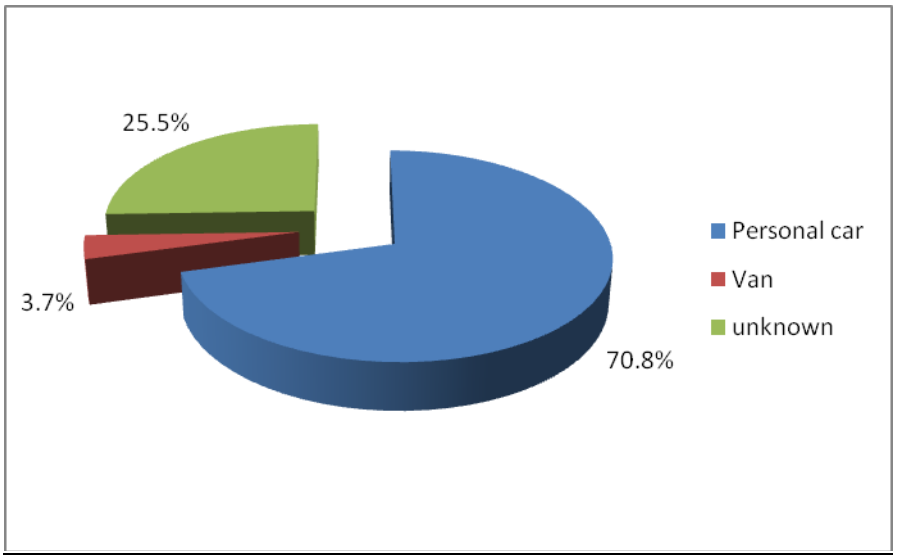


Figure 16. General distribution of study population by type of vehicle

Overall 70.8% of the study population was driving a personal car. For 25.5% no data on vehicle type were available. This proportion is attributed to the missing data in Portugal, for which data about type of vehicle was not available. Disregarding the Portuguese data, 95.1% of the sample was driving a personal car, 4.9% a small van.

Table 36. Distribution by country and type of vehicle

Type of vehicle	Country				Total
	Finland	Norway	Portugal	Sweden	
Personal car	462(95.7%)	183(94.8%)	0	147(93.6%)	792(70.8%)
Van	21(4.3%)	10(5.2%)	0	10(6.4%)	41(3.7%)
unknown	0	0	285(100%)	0	285(25.5%)
Total	483(100%)	193(100%)	285(100%)	157(100%)	**1118**

Disregarding the Portuguese data, no significant difference was found between the other countries. (p = 0.585)

3.4.7 Distribution by accident type

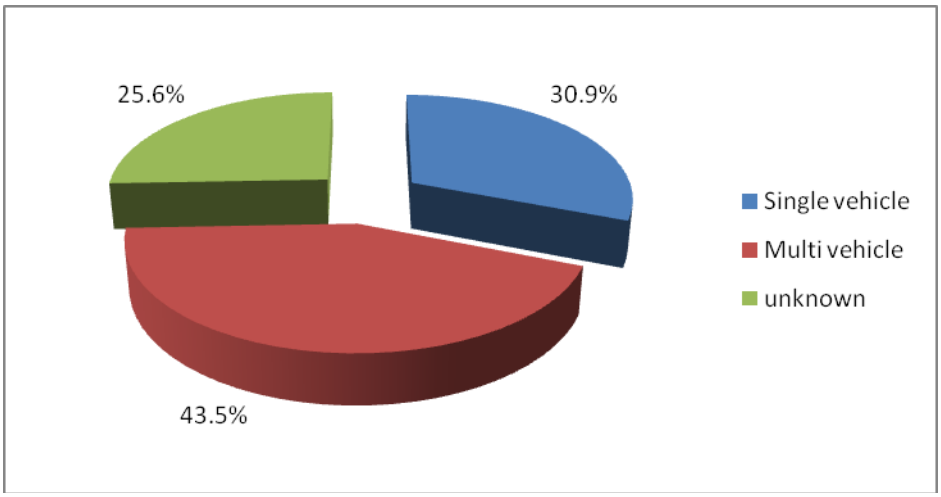


Figure 17. General distribution of study population by type of accident

Regarding the whole study population, 30.9% was involved in a single-vehicle accident and 43.5% in a multi-vehicle collision. For 25.6% the type of accident was unknown. This high percentage of unknown is due to the fact that in Portugal no data were available on this variable. Taking only into consideration the known data, of the 832 drivers, 41.6% and 58.4% were involved respectively in a single- and a multi-vehicle accident.

Table 37. Distribution by country and type of accident

Type of accident	Country				Total
	Finland	Norway	Portugal	Sweden	
Single vehicle	200(41.4%)	81(42.0%)	0	65(41.4%)	346(30.9%)
Multi vehicle	283(58.6%)	112(58.0%)	0	91(58.0%)	486(43.5%)
unknown	0	0	285(100%)	1(0.6%)	286(25.6%)
Total	483(100%)	193(100%)	285(100%)	157(100%)	**1118**

Disregarding the unknown data, there was an equal distribution between Finland, Norway and Sweden, as no significant difference was found (p = 0.991).

3.5 Prevalence of substance groups use among seriously injured drivers

3.5.1 Seriously injured drivers – Prevalence of use – Alcohol ≥ 0.1 g/L

Table 38. Prevalence of use – Alcohol

SERIOUSLY INJURED DRIVERS	BE (348)	DK (838)	FI (53)	IT (676)	LT (385)	NL (186)
Percentage of subjects positive for alcohol	42.5	19.7	32.1	23.1	17.7	29.6

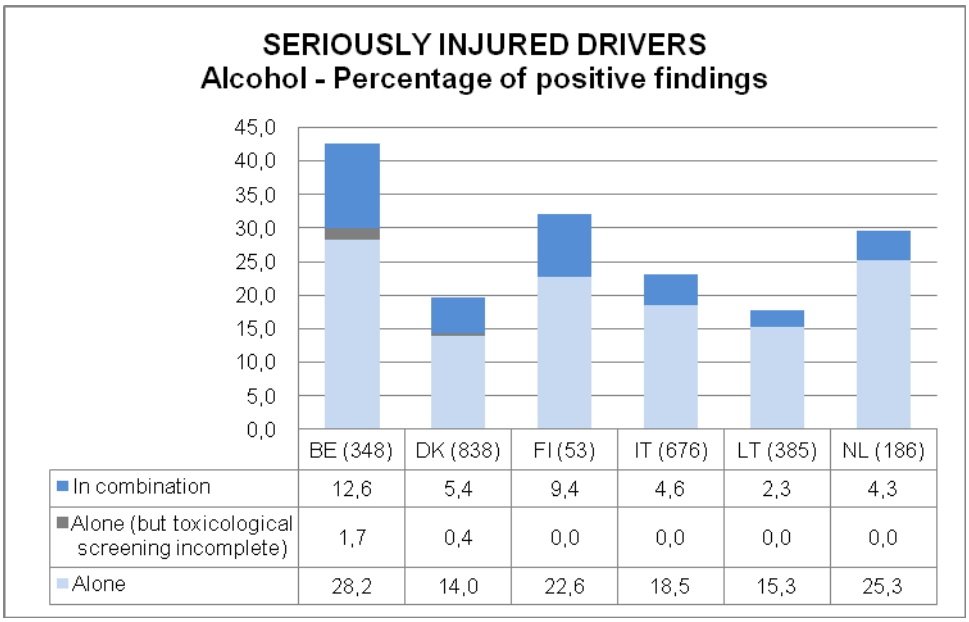


Figure 18. Prevalence of use – Alcohol: detail of toxicological findings

As expected, alcohol (cut-off= 0.1 g/L) was the most common finding. In the 6 countries participating in the seriously injured drivers study, the percentage of positive drivers in which alcohol was found alone ranged between approximately 14 and 28. The percentage of drivers in which alcohol was found in combination with other substances ranged approximately between 2 and 13. In general more male than female tested positive for alcohol presence. This happens in all age groups.

In males the percentage of positive shows a minimum of 19.3% (Lithuania) and a maximum of 50.6% (Belgium). The number of male subjects that tested positive for alcohol tend to have a peak in the age group 25-34 and then to decrease in the older age groups. This happens in all countries, apart from Belgium, where the highest percentage of positive male was found in the age group 18-24 followed by the age group 35-49.

In the female groups, the distribution of positives shows a minimum of 5.5% in Denmark and a maximum of 24.0% in Belgium. Apart from Finland, for which the low number of

samples may explain the different pattern, with positive findings dropping from 66.7% in the age group 18-24 to 0% in the other age groups, the percentage of positive subjects tend to fluctuate across different age groups. The highest percentage of positives was found in the age group 18-24 in Italy, in the age groups 25-34 in Denmark and The Netherlands, and in the age group 35-49 in Belgium and Lithuania.

In combination with drugs, alcohol was found mostly with THC and/or THCCOOH and with benzodiazepines.

Table 39. Prevalence of use – Alcohol: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for ALCOHOL						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	58.5	51.3	57.1	31.3	62.5	50.6
Denmark	25.7	36.4	26.0	17.8	100.0	27.3
Finland	35.7	50.0	33.3	22.2	N.A.	35.7
Italy	24.0	31.1	24.2	18.2	N.A.	25.0
Lithuania	22.7	21.2	18.2	11.9	25.0	19.3
The Netherlands	32.0	51.3	26.5	23.1	N.A.	34.2
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	27.8	17.9	28.1	18.2	50.0	24.0
Denmark	1.2	9.5	4.5	8.9	0.0	5.5
Finland	66.7	0.0	0.0	0.0	N.A.	18.2
Italy	19.2	19.1	14.5	14.3	N.A.	16.7
Lithuania	22.2	12.2	23.7	0.0	0.0	16.4
The Netherlands	0.0	16.7	9.1	11.1	N.A.	10.8
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

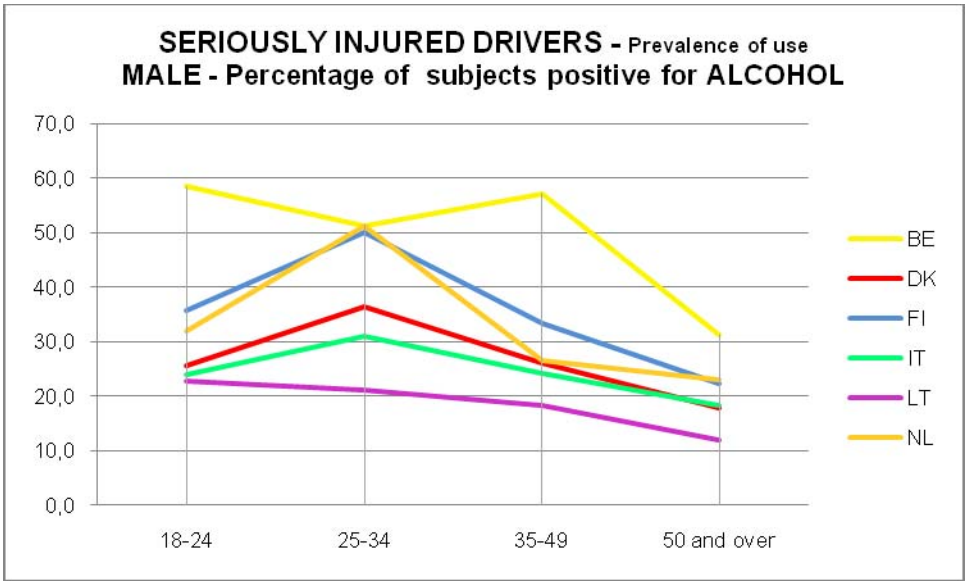


Figure 19. Prevalence of use – Alcohol: male drivers

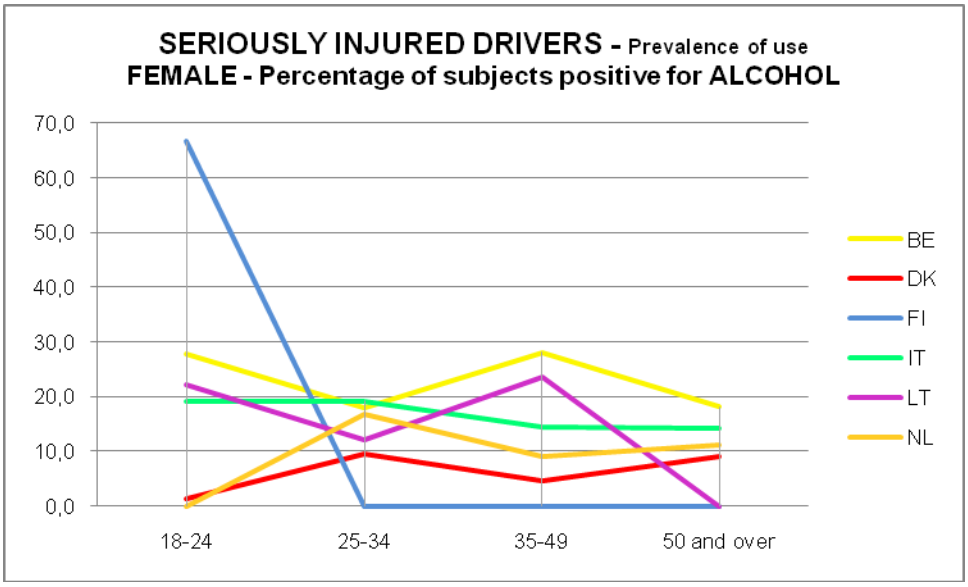


Figure 20. Prevalence of use – Alcohol: female drivers

3.5.2 Seriously injured drivers- Prevalence of use - Alcohol (≥ 0.5 g/L)

Table 40. Prevalence of use- alcohol (≥0.5g/L)

SERIOUSLY INJURED DRIVERS	BE (348)	DK (838)	FI (53)	IT (676)	LT (385)	NL (186)
Percentage of subjects tested positive for alcohol	38.2	17.8	30.2	20.6	16.1	28.0

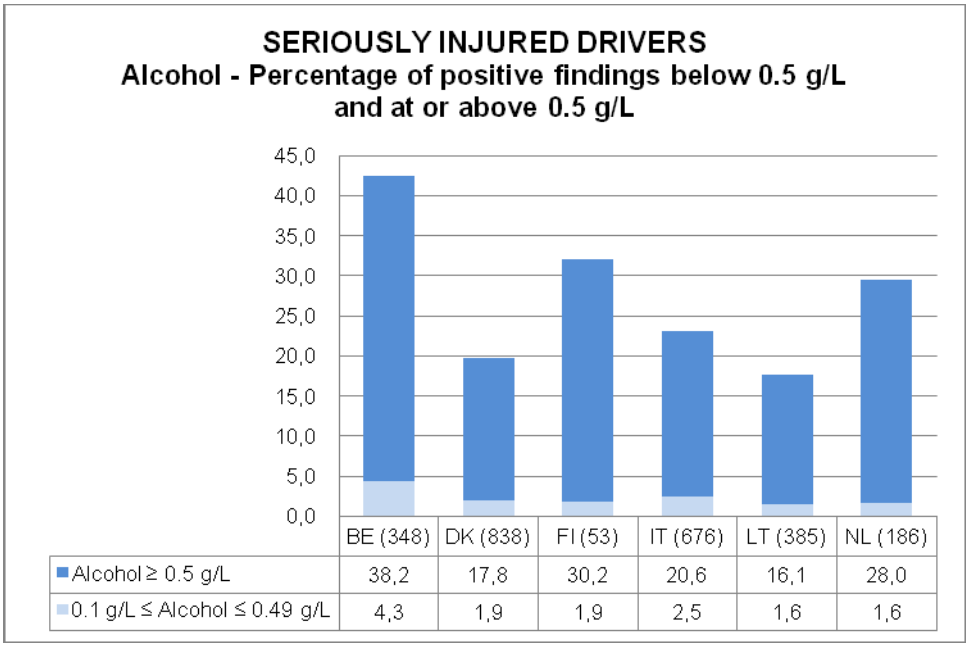


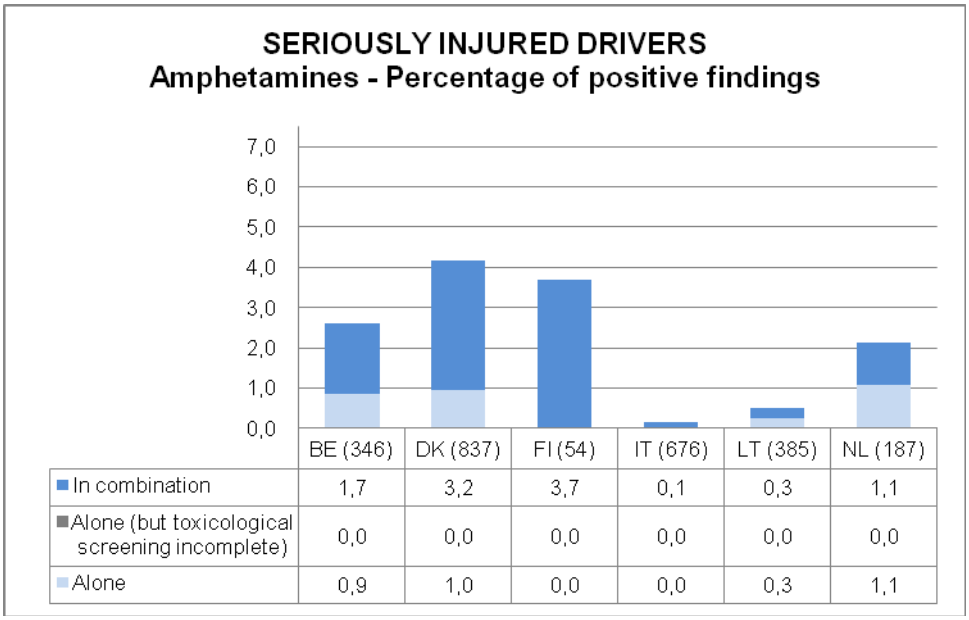
Figure 21. Prevalence of uses – alcohol (≥0.5g/L)

For alcohol (cut-off = ≥ 0.5 g/L), the highest percentage of positive cases was recorded in Belgium followed by Finland and the Netherlands.
The percentage of positive drivers in which alcohol (cut-off = ≥ 0.1 g/L) was found alone ranged between approximately 14 and 28. Using the cut-off ≥ 0.5 g/L, the percentage of positive drivers ranged between approximately 16 and 38.

3.5.3 Seriously injured drivers – Prevalence of use – Amphetamines

Table 41. Prevalence of use – Amphetamines

SERIOUSLY INJURED DRIVERS	BE (346)	DK (837)	FI (54)	IT (676)	LT (385)	NL (187)
Percentage of subjects positive for amphetamines	2.6	4.2	3.7	0.1	0.5	2.1



	BE (346)	DK (837)	FI (54)	IT (676)	LT (385)	NL (187)
In combination	1,7	3,2	3,7	0,1	0,3	1,1
Alone (but toxicological screening incomplete)	0,0	0,0	0,0	0,0	0,0	0,0
Alone	0,9	1,0	0,0	0,0	0,3	1,1

Figure 22. Prevalence of use – Amphetamines: detail of toxicological findings

In the 6 countries participating in the seriously injured drivers study, the total percentage of drivers positive for amphetamines ranges between approximately 0.1 (Italy) to 4.2 (Denmark). Except for The Netherlands, where the highest percentage of subjects was found in the female group, in the other countries more males than females tested positive for amphetamines. No positive cases were recorded in females in Denmark, Finland and Italy.

In general amphetamines appear to be used in combination with other drugs, and in particular with benzodiazepines, alcohol, cannabis (as THC and/or THCCOOH) and cocaine (found as active parent drug or its metabolite benzoylecgonine), either combined singularly or together.

The consumption tends to drop in the age group 50 and over. Only two positive cases were recorded in the older age group, one alone and one in combination with benzodiazepines. These were two male subjects, one in Belgium and one in Denmark, aged 52 and 54 respectively. The toxicological findings showed presence of amphetamine and methamphetamine, suggesting a possible therapeutic use of selegiline. This is a medication used in the treatment of early stages of Parkinson's disease, depression and senile dementia that breaks down in the body in the two detected substances[13].

[13] Goodman and Gilman. The Pharmacological basis of therapeutics, 2001. Mc Graw Hill Companies. ISBN: 0-07-112432-2.
Baselt RC. Disposition of toxic drugs and chemicals in man. Biomedical publications Foster city, California, 2004

Table 42. Prevalence of use – Amphetamines: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for AMPHETAMINES						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	1.9	5.1	3.6	2.1	0.0	3.3
Denmark	5.4	10.7	2.4	1.1	0.0	5.3
Finland	0.0	10.0	11.1	0.0	N.A.	4.7
Italy	0.0	0.0	0.7	0.0	N.A.	0.2
Lithuania	0.0	0.0	3.0	0.0	0.0	0.8
The Netherlands	4.0	2.6	0.0	0.0	N.A.	2.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	5.6	0.0	0.0	0.0	0.0	1.0
Denmark	3.7	3.2	1.1	0.0	0.0	2.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	0.0	0.0	0.0	N.A.	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	8.3	0.0	0.0	N.A.	2.7
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

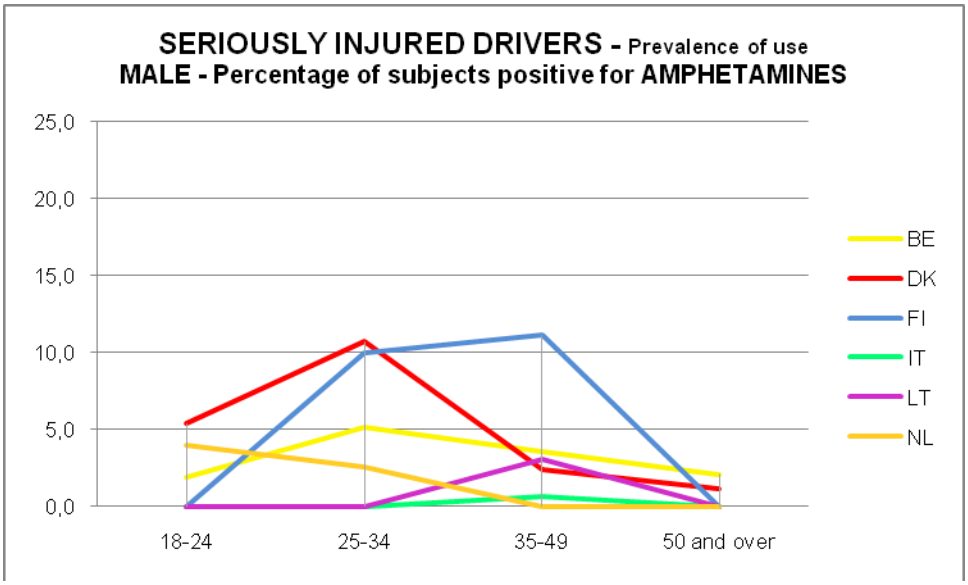


Figure 23. Prevalence of use – Amphetamines: male drivers

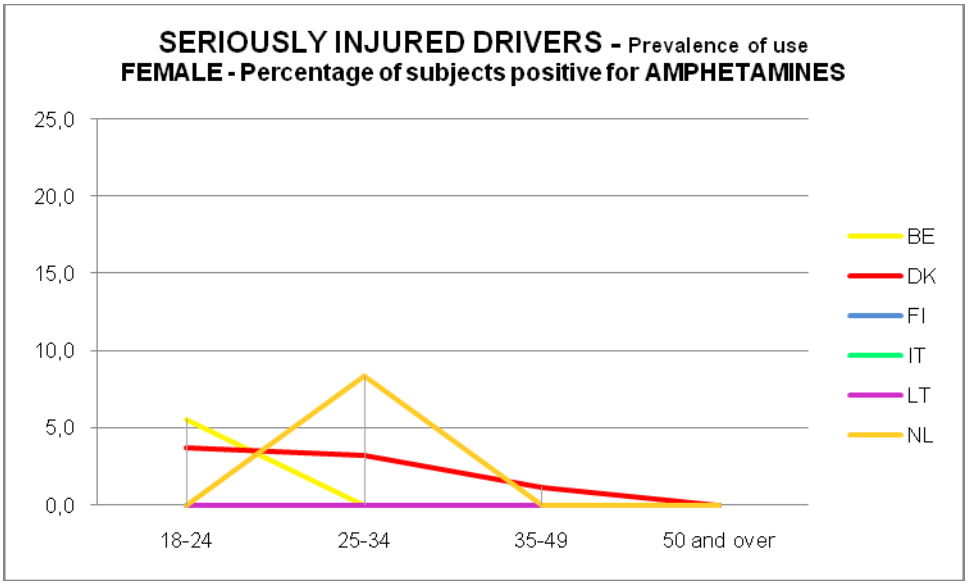


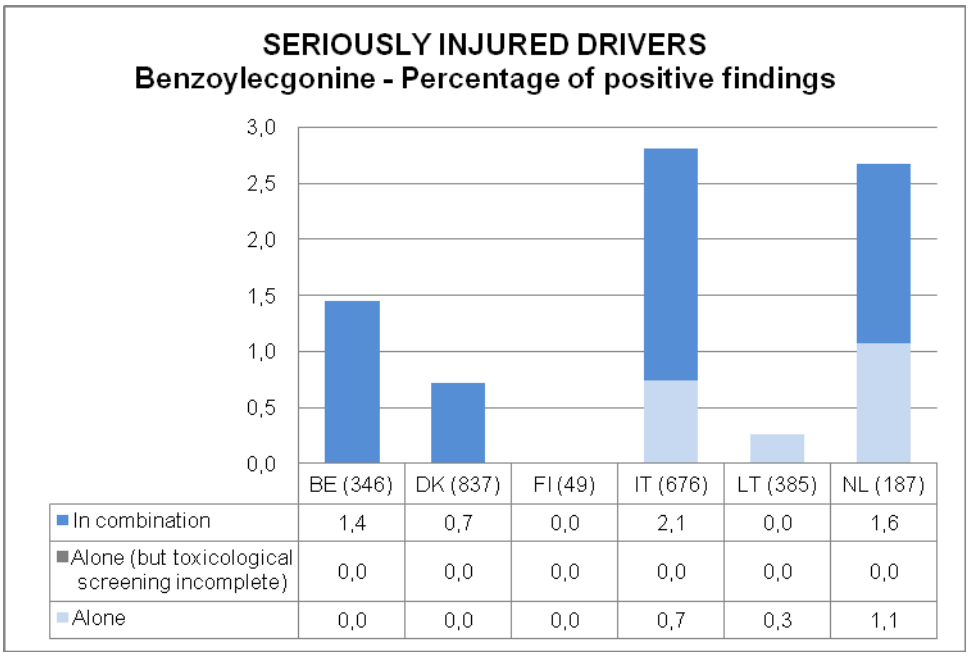
Figure 24. Prevalence of use – Amphetamines: female drivers

3.5.4 Seriously injured drivers – Prevalence of use – Benzoylecgonine

Data about benzoylecgonine and cocaine are presented in separate tables and graphs, because of the substance groups classification. However, for a whole picture of the use of cocaine among the sampled subpopulations, the two sets of data should be considered together.

Table 43. Prevalence of use – Benzoylecgonine

SERIOUSLY INJURED DRIVERS	BE (346)	DK (837)	FI (49)	IT (676)	LT (385)	NL (187)
Percentage of subjects positive for benzoylecgonine (but negative for cocaine)	1.4	0.7	0.0	2.8	0.3	2.7



	BE (346)	DK (837)	FI (49)	IT (676)	LT (385)	NL (187)
In combination	1,4	0,7	0,0	2,1	0,0	1,6
Alone (but toxicological screening incomplete)	0,0	0,0	0,0	0,0	0,0	0,0
Alone	0,0	0,0	0,0	0,7	0,3	1,1

Figure 25. Prevalence of use – Benzoylecgonine: detail of toxicological findings

For benzoylecgonine (without the presence of cocaine), the highest percentage of positive cases was recorded in Italy followed by The Netherlands and Belgium. Use appears to be more common among males. Apart from Belgium, where the percentage of positives is spread through all age groups, in the other 5 countries percentage of positives for benzoylecgonine drop to zero in the age group 50 and over.

Consumption is combined with alcohol or other drugs in the majority of cases, the association with alcohol, cannabis, illicit opiates, amphetamines and benzodiazepines, singularly or together, being the most common.

Table 44. Prevalence of use – Benzoylecgonine: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for BENZOYLECGONINE (without cocaine)						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	1.9	1.3	1.8	2.1	0.0	1.6
Denmark	1.1	1.4	0.8	0.0	0.0	0.9
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	5.0	5.0	3.4	0.0	N.A.	3.5
Lithuania	0.0	1.9	0.0	0.0	0.0	0.4
The Netherlands	2.0	5.1	5.7	0.0	N.A.	3.3
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	3.6	0.0	0.0	0.0	1.0
Denmark	0.0	0.0	1.1	0.0	0.0	0.3
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	2.1	0.0	0.0	N.A.	0.6
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

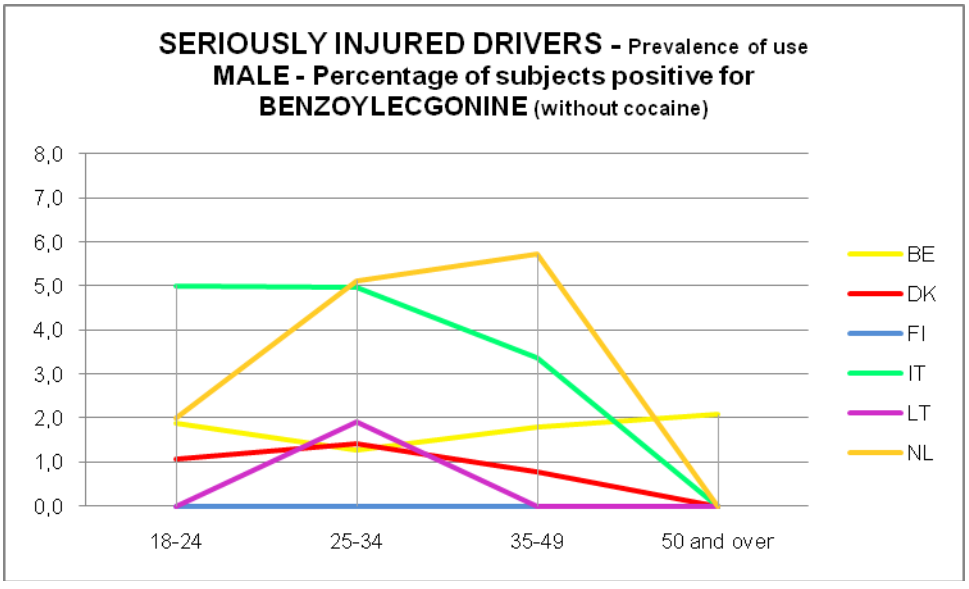


Figure 26. Prevalence of use – Benzoylecgonine: male drivers

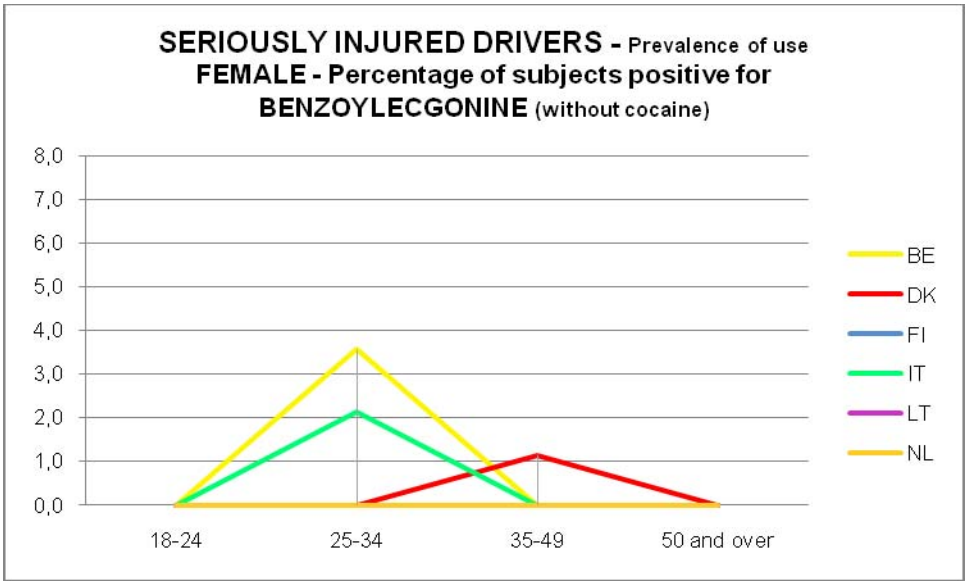


Figure 27. Prevalence of use – Benzoylecgonine: female drivers

3.5.5 Seriously injured drivers – Prevalence of use – Cocaine

Table 45. Prevalence of use – Cocaine

SERIOUSLY INJURED DRIVERS	BE (346)	DK (837)	FI (53)	IT (676)	LT (385)	NL (187)
Percentage of subjects positive for cocaine	2.3	0.6	0.0	2.7	0.3	2.1

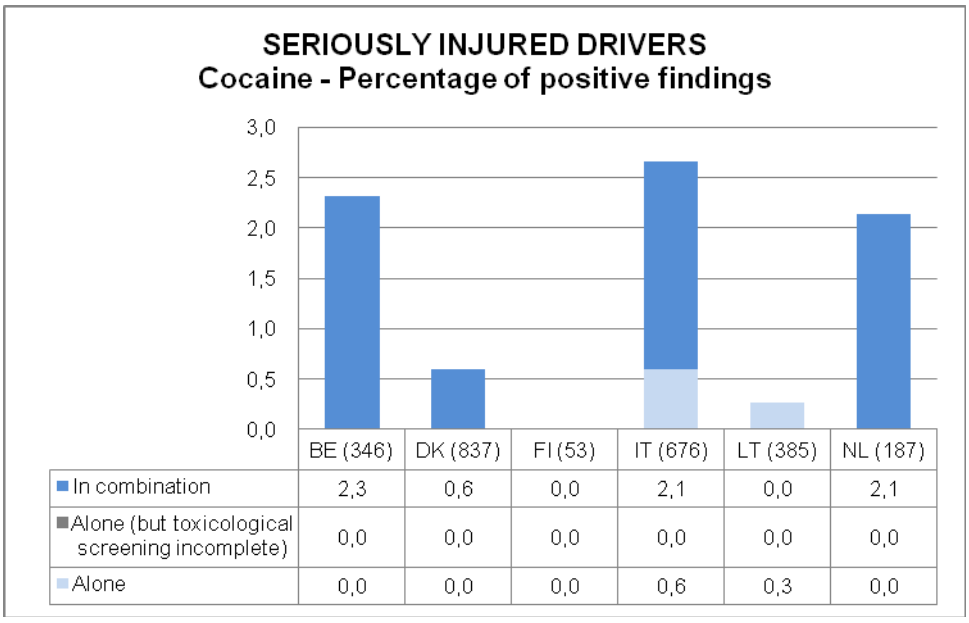


Figure 28. Prevalence of use – Cocaine: detail of toxicological findings

For cocaine (alone or in the presence of benzoylecgonine), as expected, the picture is similar to the one of benzoylecgonine. The highest percentage of positive cases was again recorded in Italy followed by Belgium and The Netherlands. Apart from The Netherlands, higher percentage of positive subjects were recorded among the male group, with no cases at all positive for cocaine in females in Belgium, Denmark, Finland and Lithuania. Apart from one positive case in Lithuania, in the other countries no cocaine was found in the age group 50 and over.

As for benzoylecgonine, positive findings for cocaine are mostly associated with positive findings for alcohol, cannabis, amphetamines, benzodiazepines and illicit opiates, singularly or together.

Table 46. Prevalence of use – Cocaine: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for COCAINE						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	1.9	6.4	1.8	0.0	12.5	3.3
Denmark	1.1	2.1	0.0	0.0	0.0	0.9
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	2.0	3.1	6.7	0.0	N.A.	3.3
Lithuania	0.0	0.0	0.0	2.4	0.0	0.4
The Netherlands	2.0	5.1	0.0	0.0	N.A.	2.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	2.1	0.0	0.0	N.A.	0.6
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	8.3	0.0	0.0	N.A.	2.7
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

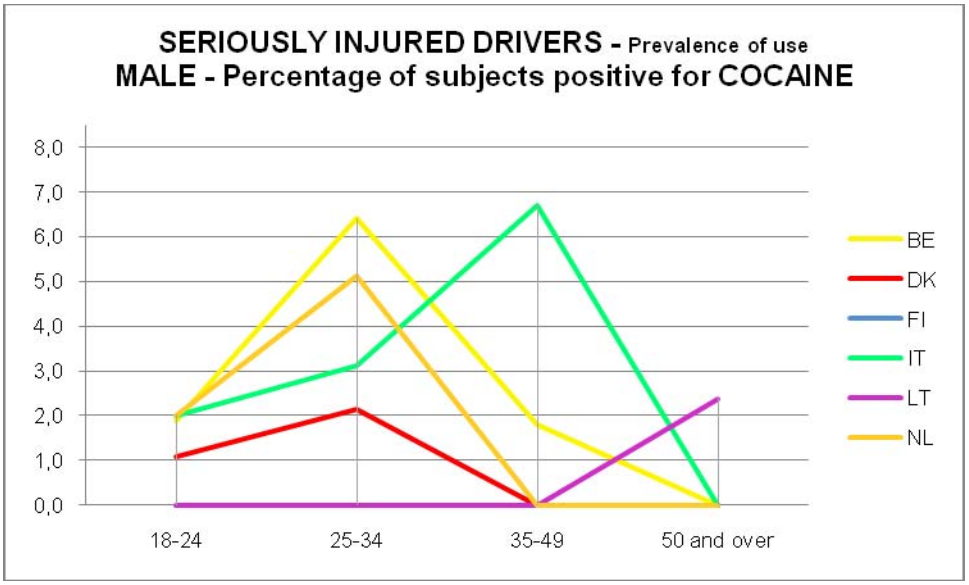


Figure 29. Prevalence of use – Cocaine: male drivers

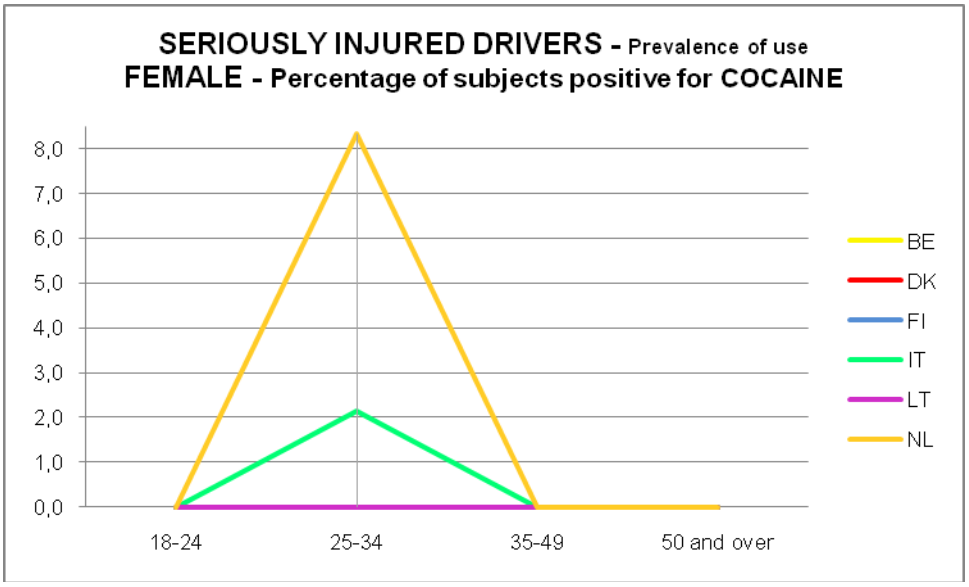


Figure 30. Prevalence of use – Cocaine: female drivers

3.5.6 Seriously injured drivers – Prevalence of use – Cocaine and/or benzoylecgonine

When combined, data for cocaine and benzoylecgonine show the highest percentage of positive cases in Italy, followed by The Netherlands and Belgium. The number of positives is normally higher in the male group, in which again Italy has the biggest number of cases followed by The Netherlands and Belgium. No cases of cocaine/benzoyleconine were recorded in Finland, both in the male and female groups. In Lithuania no cases of cocaine/benzoylecgonine were recorded in the female group. The majority of subjects that tested positive for cocaine/benzoylecgonine tested positive also

for other substances, with the most common combinations being with alcohol, cannabis, illicit opiates, benzodiazepines and amphetamines.

Table 47. Prevalence of use – Cocaine and/or benzoylecgonine

SERIOUSLY INJURED DRIVERS	BE (346)	DK (837)	FI (49)	IT (676)	LT (385)	NL (187)
Percentage of subjects tested positive for cocaine and/or benzoylecgonine	3.8	1.3	0.0	5.5	0.5	4.8

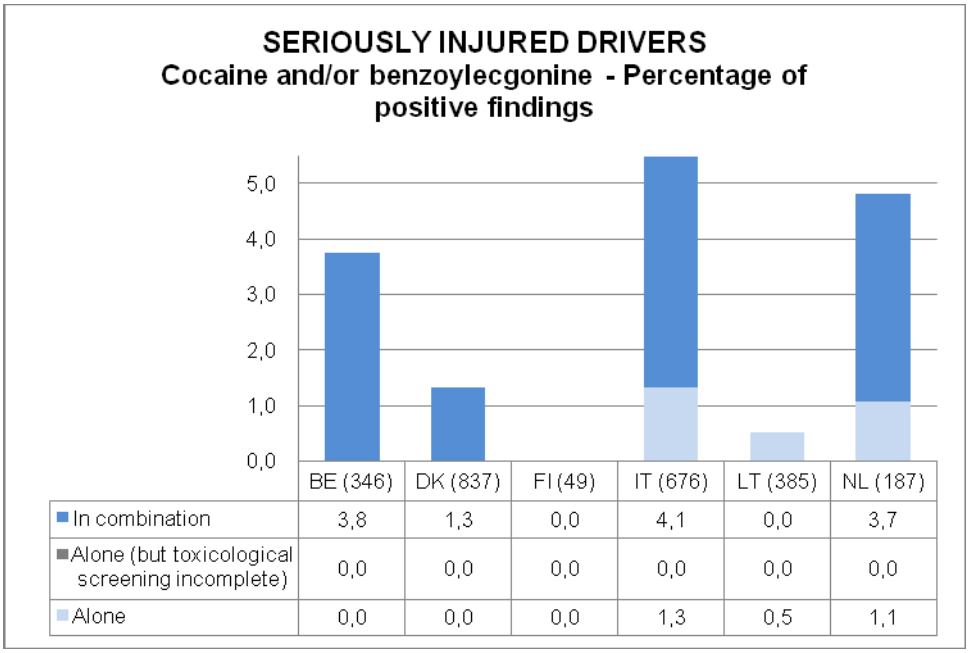


Figure 31. Prevalence of use - Cocaine and/or benzoylecgonine

Table 48. Prevalence of use – Cocaine and/or Benzoylecgonine: detail on gender and age groups

Prevalence of use - Percentage of drivers tested positive for COCAINE and/or BENZOYLECGONINE						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	3.8	7.7	3.6	2.1	12.5	4.9
Denmark	2.2	3.6	0.8	0.0	0.0	1.8
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	7.0	8.1	10.1	0.0	N.A.	6.7
Lithuania	0.0	1.9	0.0	2.4	0.0	0.8
The Netherlands	4.0	10.3	5.7	0.0	N.A.	5.3
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	3.6	0.0	0.0	0.0	1.0
Denmark	0.0	0.0	1.1	0.0	0.0	0.3
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	4.3	0.0	0.0	N.A.	1.3
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	8.3	0.0	0.0	N.A.	2.7
UNKNOWN GENDER	**Among subjects of the same age group**					**Among all subjects of unknown gender**
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

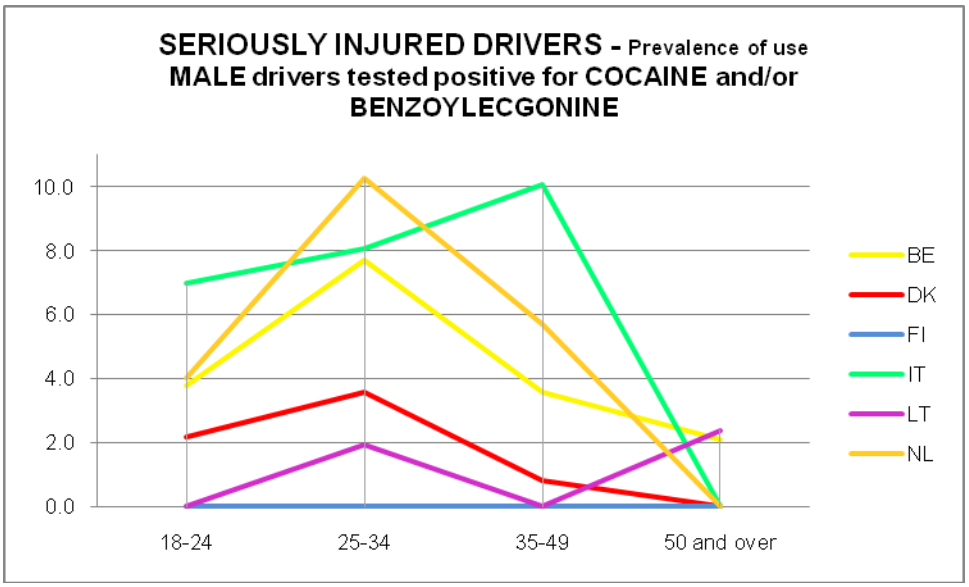


Figure 32. Prevalence of use – Cocaine and/or Benzoylecgonine : Male drivers

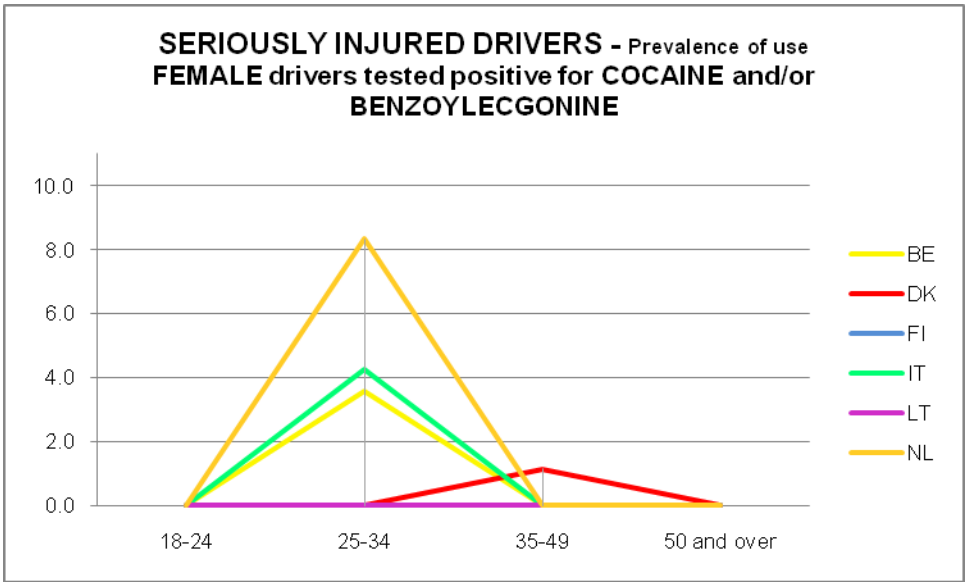


Figure 33. Prevalence of use – Cocaine and/or Benzoylecgonine : Female drivers

3.5.7 Seriously injured drivers – Prevalence of use – THCCOOH

Data about THCCOOH and THC are presented in separate tables and graphs, because of the substance group classification. However, for a whole picture of the use of cannabis among the sampled subpopulations, the two sets of data should be considered together, THCCOOH being the metabolite of THC in the body.

Table 49. Prevalence of use – THCCOOH

SERIOUSLY INJURED DRIVERS	BE (344)	DK (836)	FI (53)	IT (676)	LT (385)	NL (187)
Percentage of subjects positive for THCCOOH (but negative for THC)	2.3	5.3	0.0	1.3	0.3	1.1

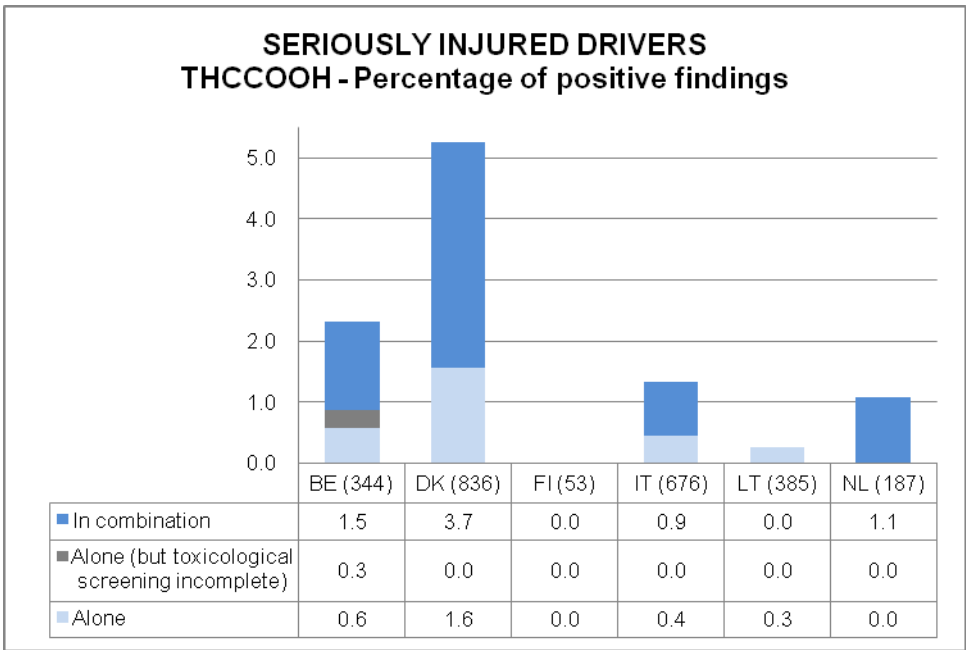


Figure 34. Prevalence of use – THCCOOH: detail of toxicological findings (combination with THC not included)

For THCCOOH (without the presence of THC), the highest percentage of positive cases was recorded in Denmark, followed by Belgium and Italy. Denmark is the only country in which cases of THCCOOH only were recorded both in the male and the female groups, while in the other 5 countries no cases were recorded in the female group. The number of positive findings tend to decrease sharply in the age group 50 and over, reaching zero in all countries apart from Denmark and Belgium.

Consumption is often combined, and THCCOOH is mostly found with alcohol, benzodiazepines and cocaine/benzoylecgonine. Several cases appear also in association with opioids, both of the medicinal and of the illicit group.

Table 50. Prevalence of use – THCCOOH: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for THCCOOH (without THC)						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	1.9	6.4	0.0	4.3	0.0	3.3
Denmark	7.5	7.9	8.7	1.1	0.0	6.8
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	3.0	2.5	1.3	0.0	N.A.	1.7
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	5.1	0.0	0.0	N.A.	1.3
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	1.3	4.8	3.4	0.0	0.0	2.4
Finland	0.0	0.0	0.0	0.0	N.A	0.0
Italy	0.0	0.0	0.0	0.0	N.A	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	12.5	7.7

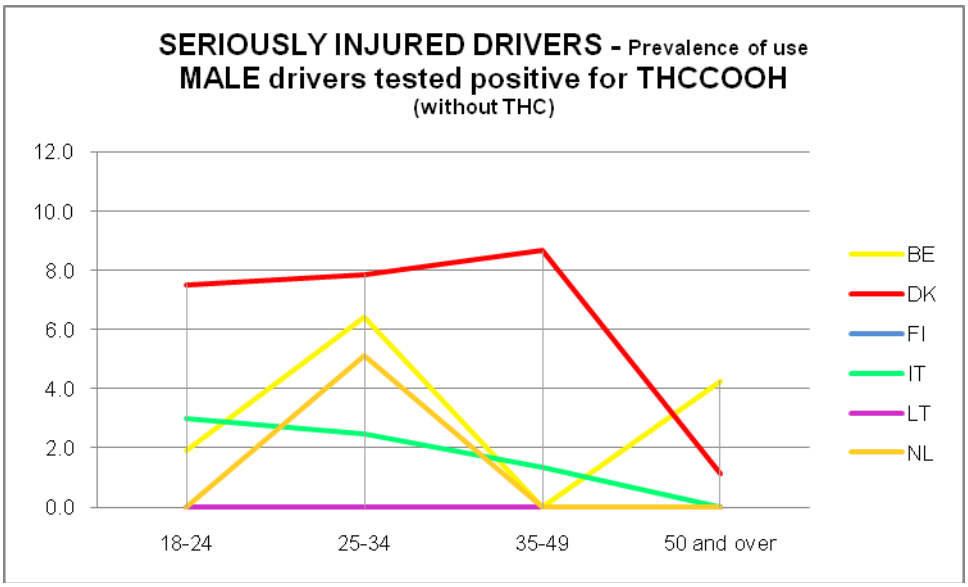


Figure 35. Prevalence of use – THCCOOH: male drivers

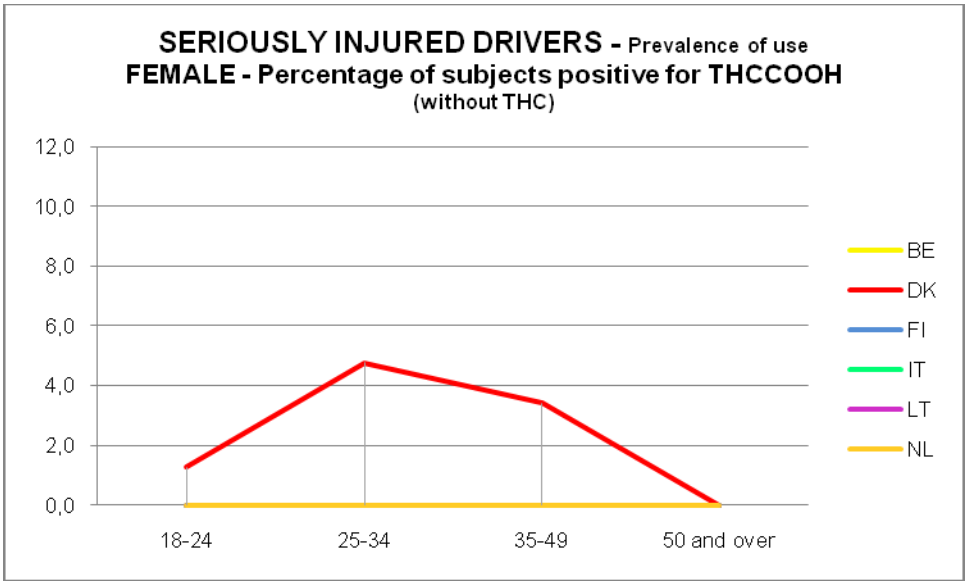


Figure 36. Prevalence of use – THCCOOH: female drivers

3.5.8 Seriously injured drivers – Prevalence of use – THC

Table 51. Prevalence of use – THC

SERIOUSLY INJURED DRIVERS	BE (344)	DK (836)	FI (53)	IT (676)	LT (385)	NL (187)
Percentage of subjects positive for THC	7.6	1.3	5.7	3.7	0.5	0.5

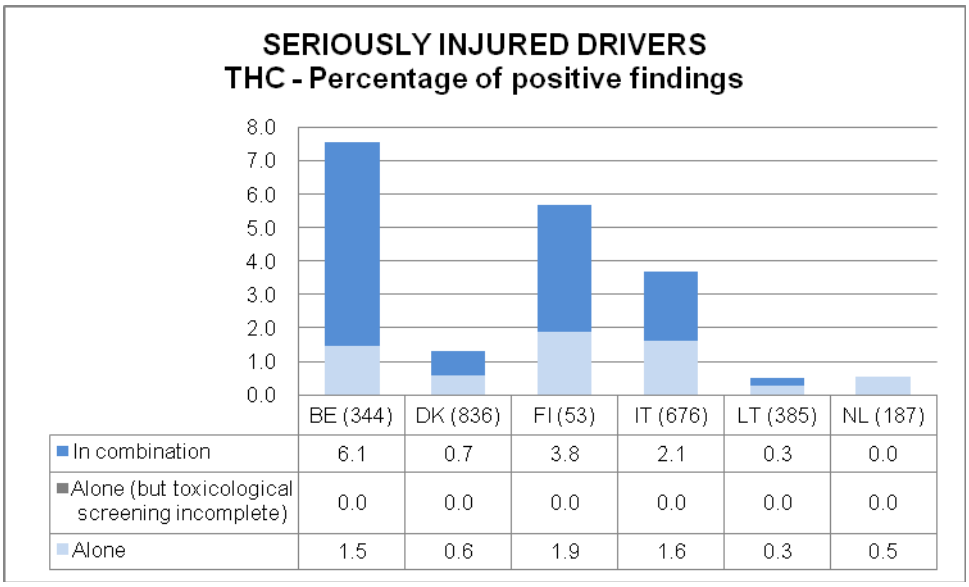


Figure 37. Prevalence of use – THC: detail of toxicological findings

The highest percentage of positive cases for THC (alone or in the presence THCCOOH) was recorded in Belgium, followed by Finland and Italy. In the male and female groups the percentage of positive findings seems to follow a different pattern in the 6 countries. Belgium has the highest number of positive cases for both the male and the female groups, with positive subjects mostly concentrated in the age groups 18-24 and 25-34.

No positive cases for THC were recorded in females of Finland, Lithuania and The Netherlands. Once again the number of positive cases drops in the age group 50 and over, with no positive cases recorded.

As in the case of THCCOOH, subjects positive for THC were often also positive for alcohol, cocaine/benzoylecgonine and benzodiazepines, either alone or in combination.

Table 52. Prevalence of use – THC: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for THC						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	17.3	16.7	1.8	0.0	12.5	10.0
Denmark	2.7	0.0	3.9	0.0	0.0	1.8
Finland	7.1	20.0	0.0	0.0	N.A.	7.1
Italy	8.0	6.8	2.7	0.0	N.A.	4.4
Lithuania	0.0	1.9	1.5	0.0	0.0	0.8
The Netherlands	0.0	2.6	0.0	0.0	N.A.	0.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	5.6	3.6	0.0	0.0	0.0	2.0
Denmark	0.0	1.6	0.0	0.0	0.0	0.3
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	2.1	1.8	0.0	N.A.	1.3
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

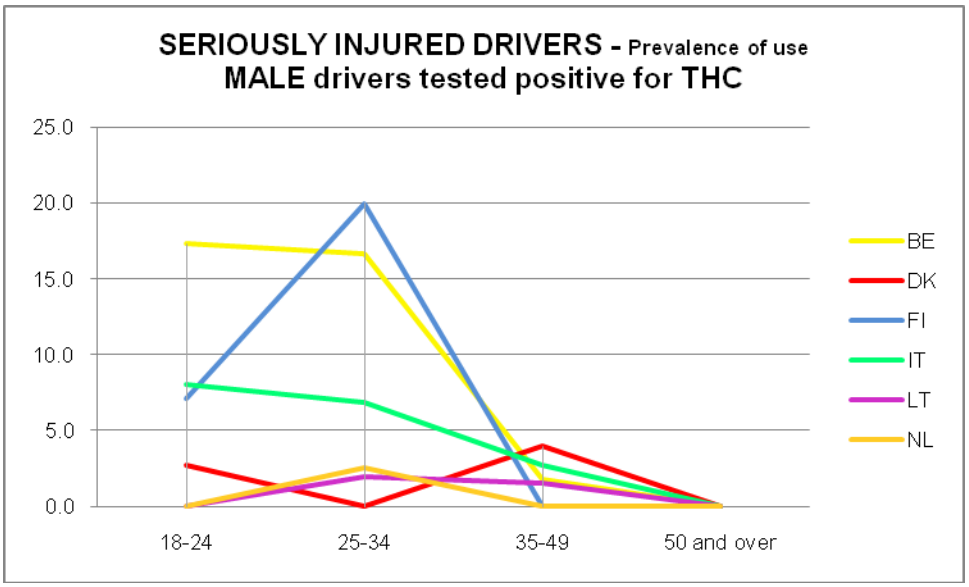


Figure 38. Prevalence of use – THC: male drivers

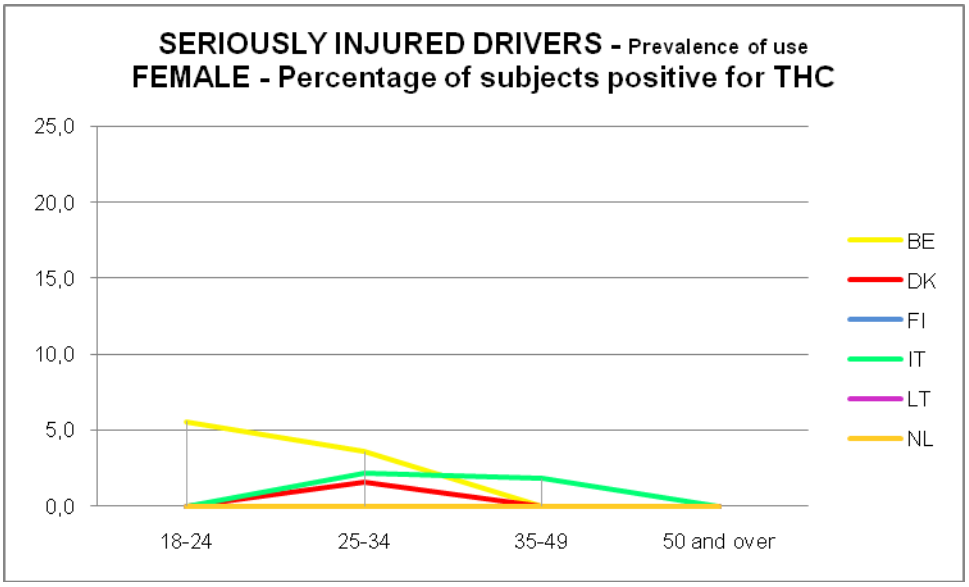


Figure 39. Prevalence of use – THC: female drivers

3.5.9 Seriously injured drivers – Prevalence of use – THC and/or THCCOOH

When combined, data for THC and THCCOOH only show the highest percentage of positive cases in Belgium, followed by Denmark and Finland. This trend is confirmed in the male group, while in the female group positive cases are found only in Denmark, Belgium and Italy, with percentages decreasing in the same order. The majority of subjects that tested positive for THC and/or THCCOOH also tested positive for other substances, with the most common combinations being with alcohol, cocaine/benzoylecgonine and benzodiazepines. Combination with amphetamines is also present as well as with opioids, especially medicinal. All of these appear as single or multiple combinations. In the prevalence of use, among the whole subpopulation of

sampled drivers, subjects positive for THC and/or THCCOOH make the second largest group after the ones positive for alcohol.

Table 53. Prevalence of use- THC and/or THCCOOH

SERIOUSLY INJURED DRIVERS	BE (344)	DK (836)	FI (53)	IT (676)	LT (385)	NL (187)
Percentage of subjects tested positive for THC and/or THCCOOH	9.9	6.6	5.7	5.0	0.8	1.6

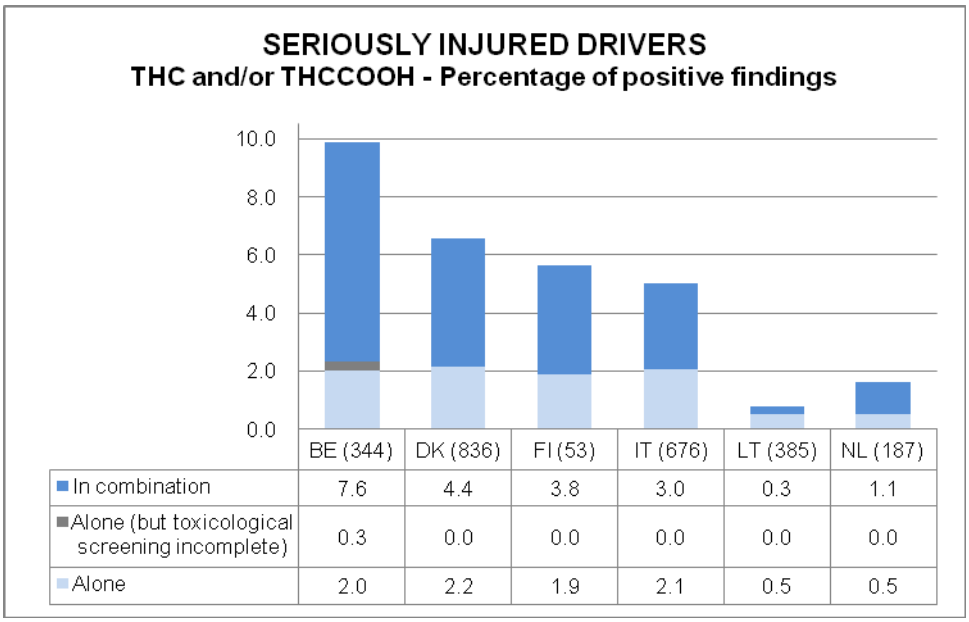


Figure 40. Prevalence of use – THC and/or THCCOOH

Table 54. Prevalence of use – THC and/or THCCOOH : detail gender and age groups

Prevalence of use - Percentage of drivers tested positive for THC and/or THCCOOH						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	19.2	23.1	1.8	4.3	12.5	13.3
Denmark	10.2	7.9	12.6	1.1	0.0	8.6
Finland	7.1	20.0	0.0	0.0	N.A.	7.1
Italy	11.0	9.3	4.0	0.0	N.A.	6.2
Lithuania	0.0	1.9	1.5	0.0	0.0	0.8
The Netherlands	0.0	7.7	0.0	0.0	N.A.	2.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	5.6	3.6	0.0	0.0	0.0	2.0
Denmark	1.3	6.3	3.4	0.0	0.0	2.7
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	2.1	1.8	0.0	N.A.	1.3
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	12.5	7.7

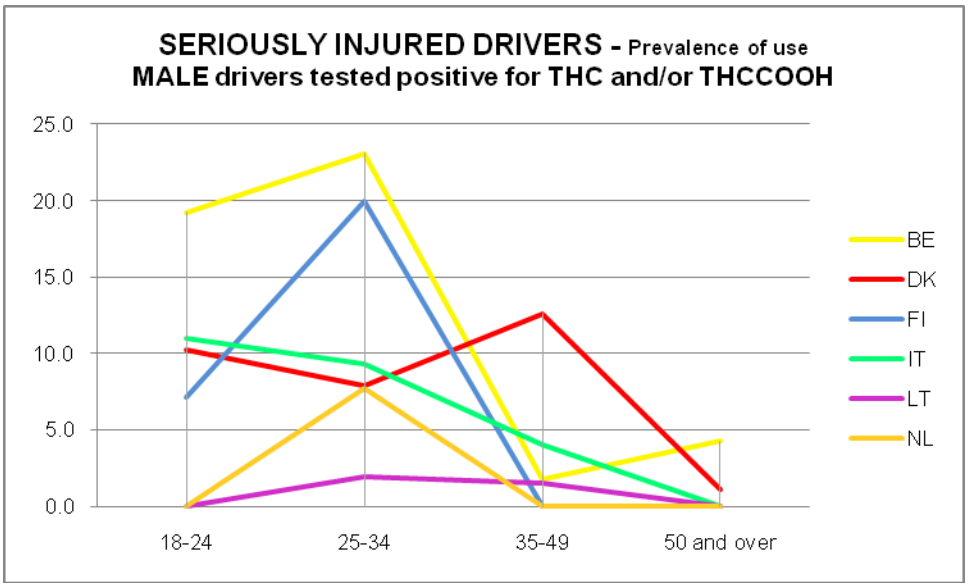


Figure 41. Prevalence of use – THC and/or THCCOOH : Male drivers

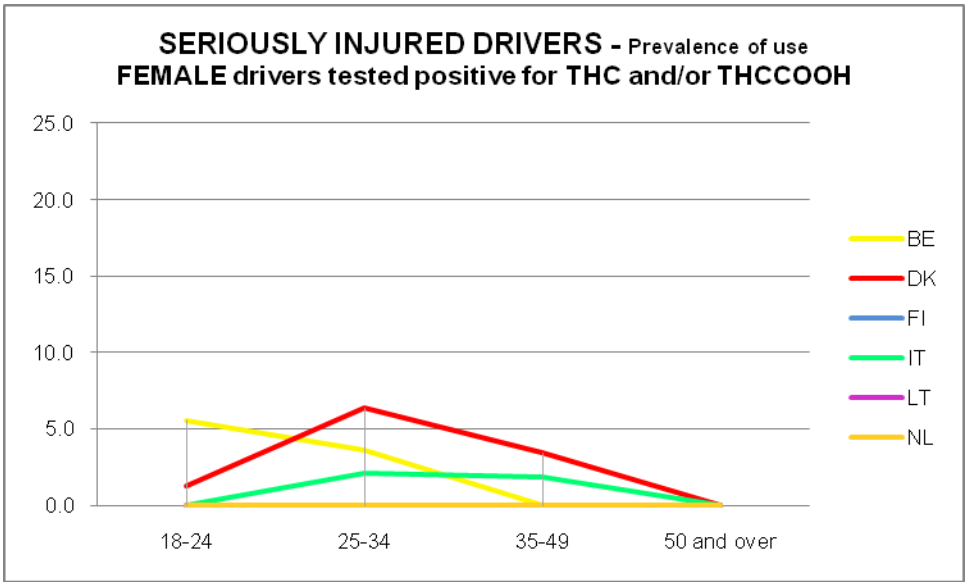


Figure 42. Prevalence of use – THC and/or THCCOOH : Female drivers

3.5.10 Seriously injured drivers – Prevalence of use – Illicit opiates

As already reported, in this chapter, concentrations of 6-acetylmorphine and codeine were considered even if below the set cut-offs, to allow classification of illicit opiates use more close to reality. For this reason, percentage found herein are likely to be higher than the ones reported in the country reports, with the exception of Italy, that used toxicological findings on urine samples to distinguish cases of illicit opiates use from the medicinal ones.

Table 55. Prevalence of use – Illicit opiates

SERIOUSLY INJURED DRIVERS	BE (346)	DK (837)	FI (53)	IT (676)	LT (385)	NL (187)
Percentage of subjects positive for illicit opiates	0.6	0.5	0.0	2.1	0.3	0.0

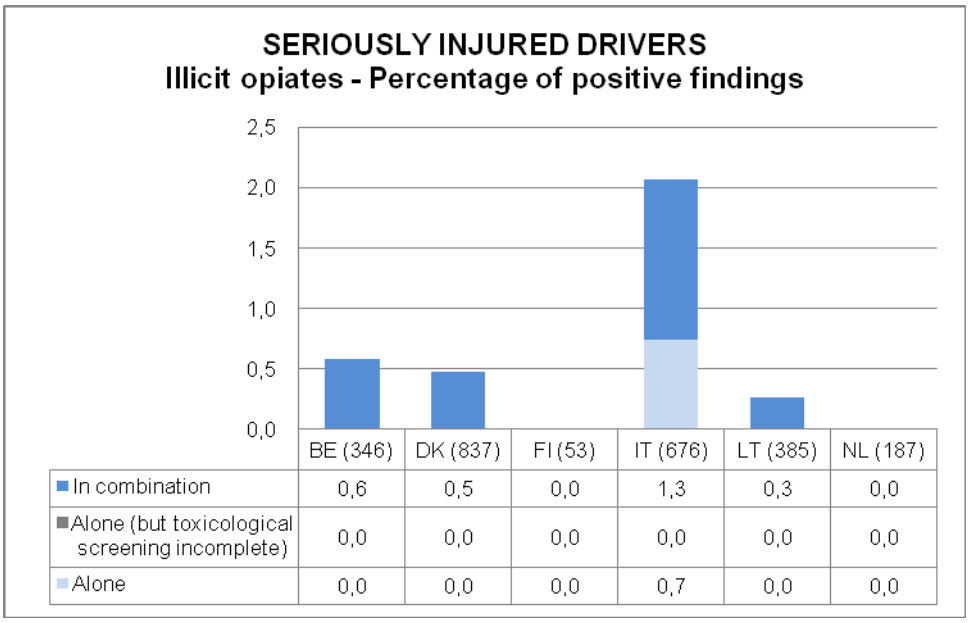


Figure 43. Prevalence of use – Illicit opiates: detail of toxicological findings

No cases of illicit opiates were detected in Finland and The Netherlands. In the other countries the highest percentage of subjects positive for illicit opiates was found in Italy, followed by Belgium, Denmark and Lithuania. Apart from one case registered in Italy, all subjects positive for illicit opiates were males. In general the age groups 24-34 and 35-49 appear to be the bigger consumers of illicit opiates.
Out of 21 cases detected, only 5 are not in combination with other drugs. The most common combinations are with cocaine/benzoylecgonine and THC/THCCOOH, followed by ethanol, benzodiazepines and medicinal opioids.

Table 56. Prevalence of use – Illicit opiates: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for ILLICIT OPIATES						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	1.3	0.0	2.1	0.0	0.8
Denmark	0.0	0.0	3.1	0.0	0.0	0.7
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	2.0	3.7	3.4	0.0	N.A.	2.5
Lithuania	0.0	1.9	0.0	0.0	0.0	0.4
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	2.1	0.0	0.0	N.A.	0.6
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

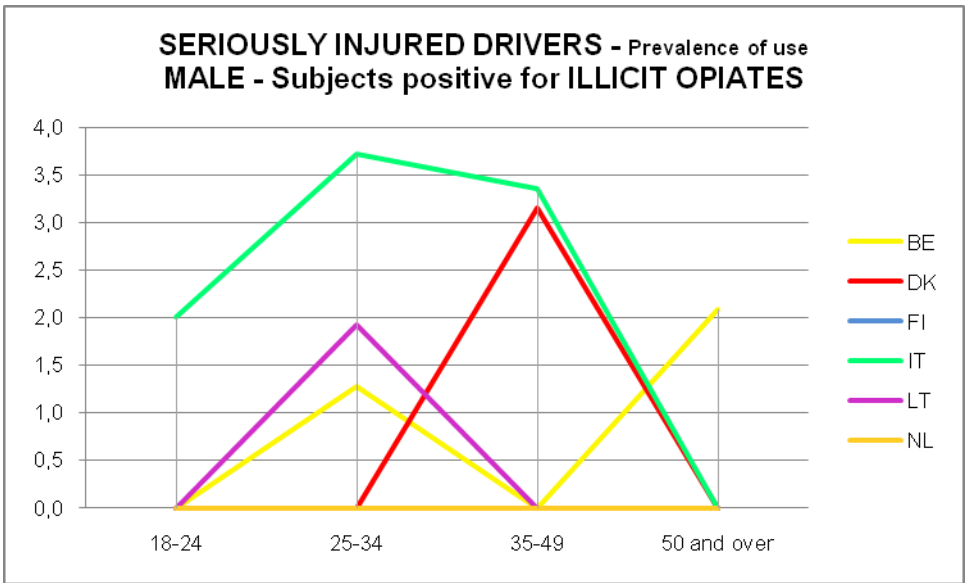


Figure 44. Prevalence of use – Illicit opiates: male drivers

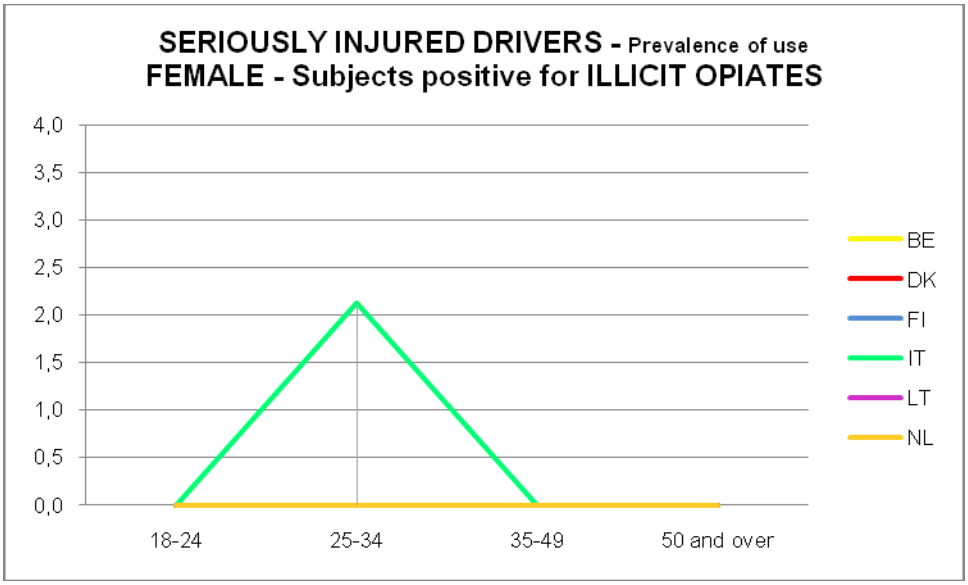


Figure 45. Prevalence of use – Illicit opiates: female drivers

3.5.11 Seriously injured drivers – Prevalence of use – Benzodiazepines

Table 57. Prevalence of use – Benzodiazepines

SERIOUSLY INJURED DRIVERS	BE (342)	DK (835)	FI (49)	IT (676)	LT (385)	NL (187)
Percentage of subjects positive for benzodiazepines	7.3	6.7	10.2	0.7	3.6	0.0

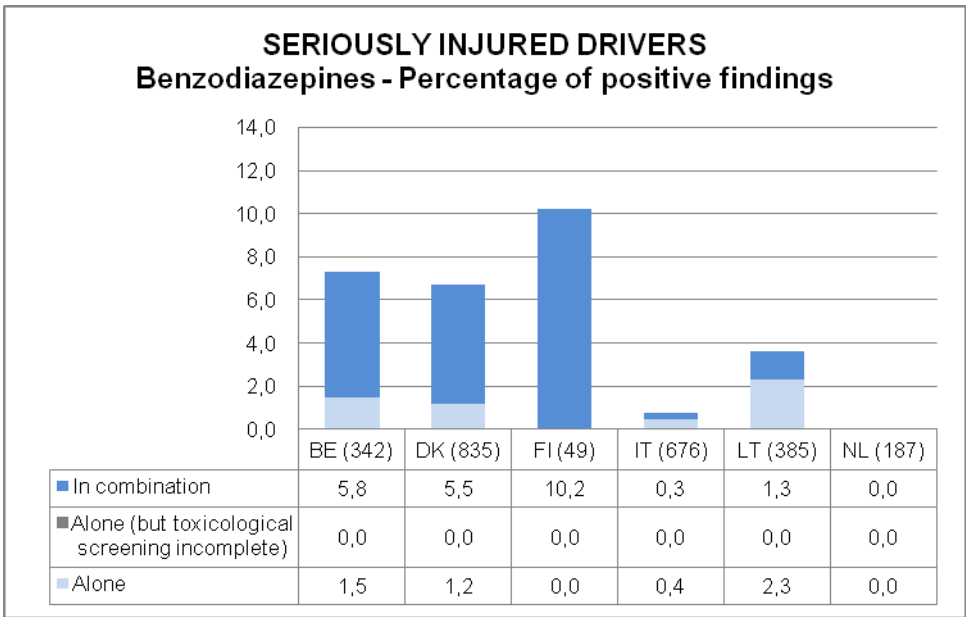


Figure 46. Prevalence of use – Benzodiazepines: detail of toxicological findings

Finland, Belgium and Denmark had the highest percentage of subjects positive for benzodiazepines. The Netherlands is the only country in which no subject was found positive for benzodiazepines. With different patterns, consumption seems to be spread over both genders and all age groups. The vast majority of cases are in combination with alcohol, THC and/or THCCOOH, amphetamines and medicinal opioids.

Although the number of Finnish samples selected for the this general part is very low, similar percentages of subjects positive for benzodiazepines were found both in the whole population of Finnish injured drivers (9.6%) and killed drivers (13.3%) Statistically no difference is found between Belgium and Denmark.

Table 58. Prevalence of use – Benzodiazepines: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for BENZODIAZEPINES						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	1.9	1.3	14.5	6.4	37.5	6.7
Denmark	5.9	10.7	7.1	6.7	0.0	7.6
Finland	0.0	30.0	12.5	12.5	N.A.	12.8
Italy	0.0	0.0	0.0	0.9	N.A.	0.2
Lithuania	0.0	5.8	4.5	7.1	8.3	4.2
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	5.6	0.0	13.8	13.6	25.0	8.9
Denmark	2.5	6.3	4.6	7.1	20.0	5.1
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	2.1	0.0	10.7	N.A.	2.6
Lithuania	2.8	4.9	2.6	0.0	0.0	3.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

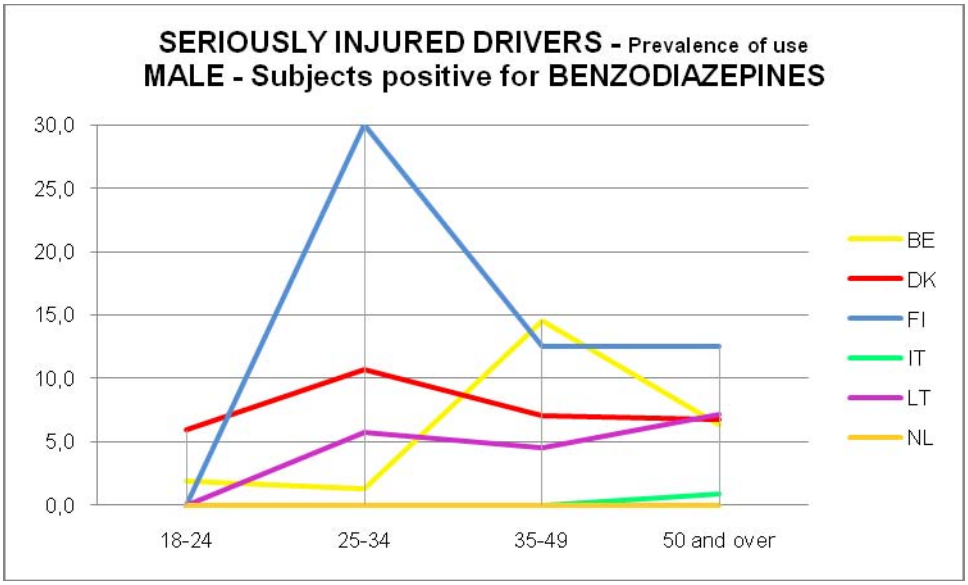


Figure 47. Prevalence of use – Benzodiazepines: male drivers

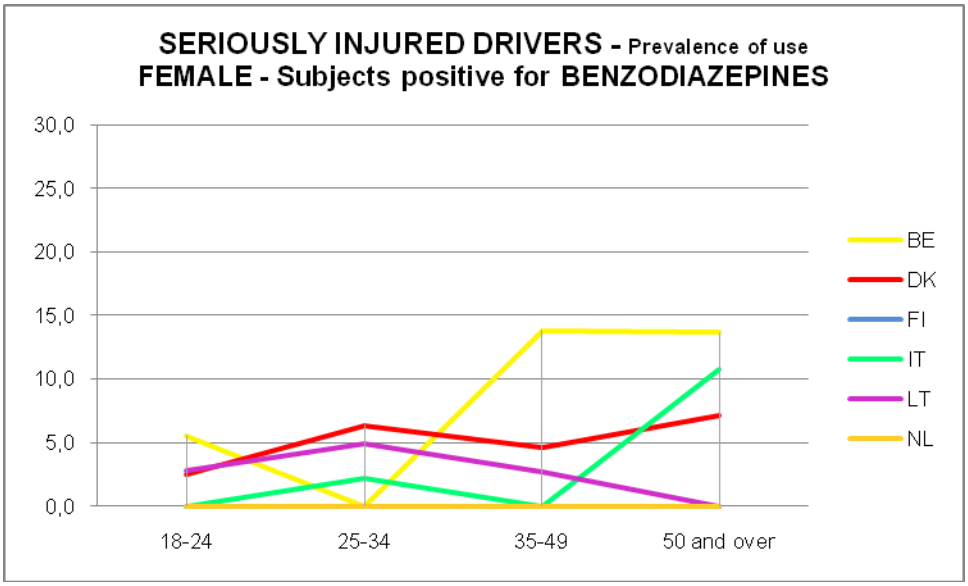


Figure 48. Prevalence of use – Benzodiazepines: female drivers

3.5.12 Seriously injured drivers – Prevalence of use – Z-drugs

Table 59. Prevalence of use – Z-drugs

SERIOUSLY INJURED DRIVERS	BE (346)	DK (837)	FI (53)	IT (676)	LT (385)	NL (187)
Percentage of subjects positive for Z-drugs	1.7	1.2	3.8	0.0	0.0	0.5

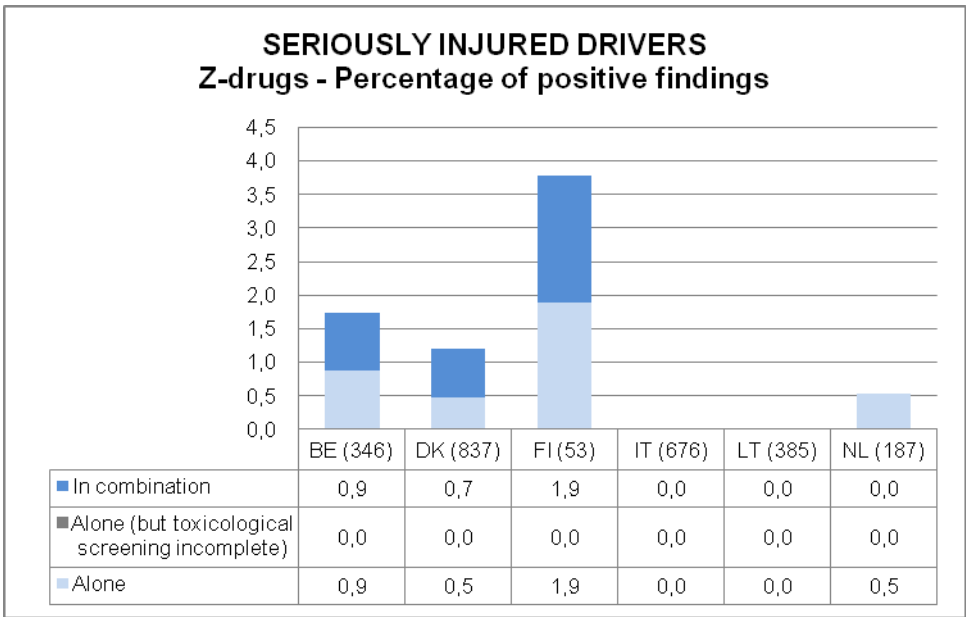


Figure 49. Prevalence of use – Z-drugs: detail of toxicological findings

The highest percentage of subjects positive for Z-drugs was found in Finland followed by Belgium and Denmark, with a pattern similar to the one found for benzodiazepines. Only one case was recorded in The Netherlands, accounting for 0.5% of the sampled subpopulation, while no positive findings for Z-drugs were recorded in Italy and Lithuania. The use appears to be more common among older age groups, with no positive subjects in the age group 18-24. Approximately half of the cases are in combination, most commonly with benzodiazepines and alcohol.

Table 60. Prevalence of use – Z-drugs: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for Z-DRUGS						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	1.8	0.0	0.0	0.4
Denmark	0.0	0.7	1.6	3.3	0.0	1.1
Finland	0.0	10.0	0.0	11.1	N.A.	4.8
Italy	0.0	0.0	0.0	0.0	N.A.	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	3.8	N.A.	0.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	10.0	0.0	50.0	4.9
Denmark	0.0	1.6	0.0	5.4	0.0	1.4
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	0.0	0.0	0.0	N.A.	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0

UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

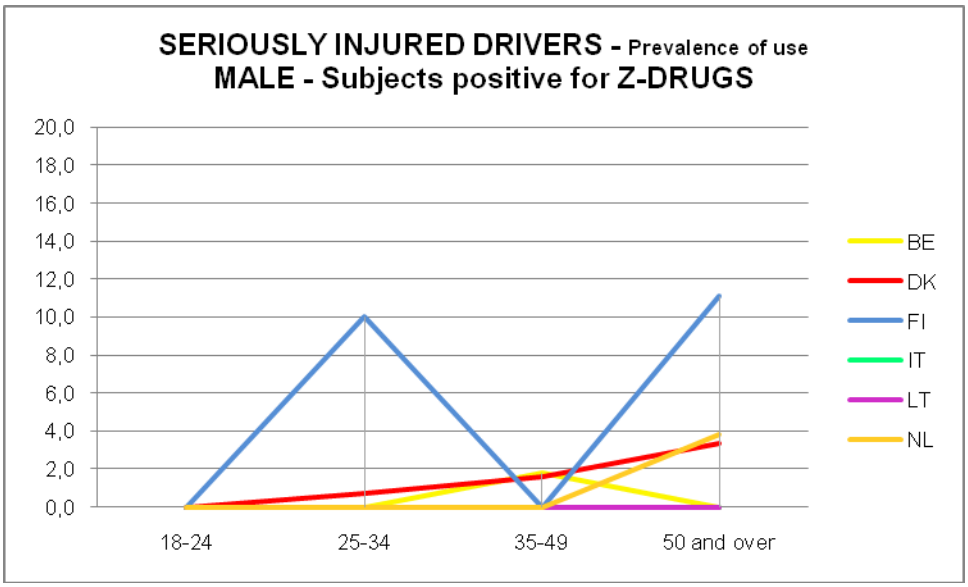


Figure 50. Prevalence of use – Z-drugs: male drivers

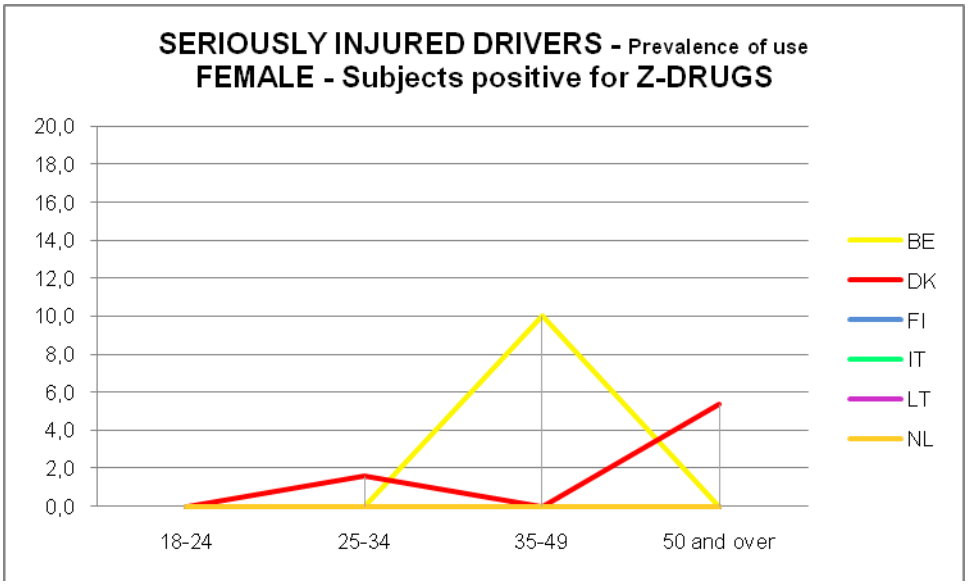


Figure 51. Prevalence of use – Z-drugs: female drivers

3.5.13 Seriously injured drivers – Prevalence of use – Medicinal opioids

Table 61. Prevalence of use – Medicinal opioids

SERIOUSLY INJURED DRIVERS	BE (332)	DK (835)	FI (50)	IT (676)	LT (385)	NL (187)
Percentage of subjects positive for medicinal opioids	3.3	4.2	4.0	3.7	7.8	0.5

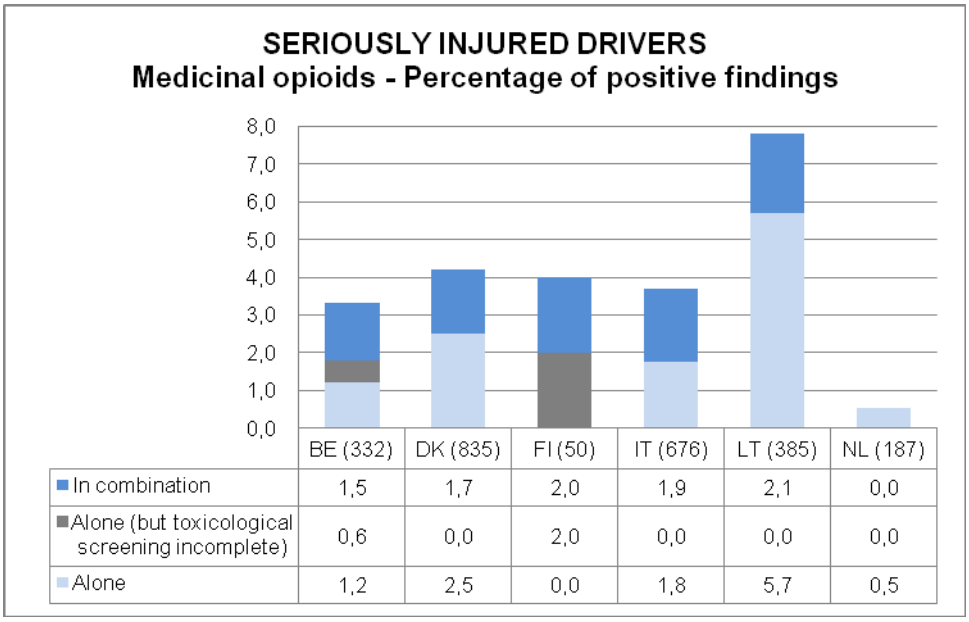


Figure 52. Prevalence of use – Medicinal opioids: detail of toxicological findings

The highest percentage of subjects positive for medicinal opioids was recorded in Lithuania. This is almost double when compared to the ones in the other countries, with the exception of The Netherlands, where only one case was recorded (0.5%). In general, subjects positive for medicinal opioids are present in both gender and in all age groups. Approximately half the cases were found in combination, with alcohol, benzodiazepines and THC and/or THCCOOH being the most common findings.

Table 62. Prevalence of use – Medicinal opioids: detail on gender and age groups

Prevalence of use - Percentage of drivers tested positive for MEDICINAL OPIOIDS						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	2.0	6.7	0.0	2.2	12.5	3.4
Denmark	0.5	2.1	7.2	6.7	0.0	3.5
Finland	0.0	0.0	12.5	0.0	N.A.	2.6
Italy	4.0	3.7	4.7	0.9	N.A.	3.5
Lithuania	10.6	7.7	7.6	14.3	16.7	10.1
The Netherlands	0.0	0.0	2.9	0.0	N.A.	0.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	3.8	6.9	0.0	0.0	3.1
Denmark	0.0	7.9	8.0	5.4	20.0	5.5
Finland	0.0	0.0	0.0	16.7	N.A.	9.1
Italy	0.0	8.5	5.5	0.0	N.A.	4.5
Lithuania	0.0	4.9	7.9	0.0	0.0	3.7
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	12.5	7.7

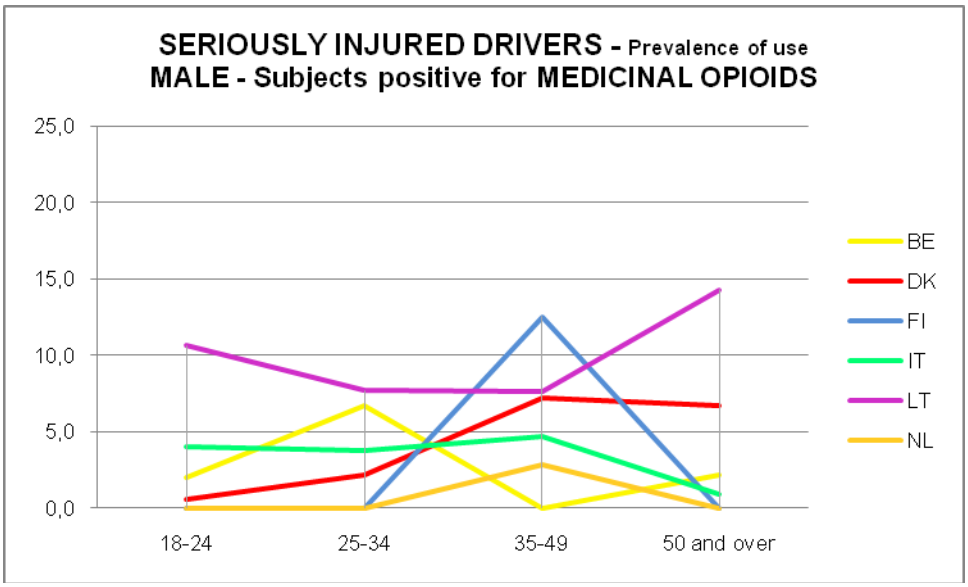


Figure 53. Prevalence of use – Medicinal opioids: male drivers

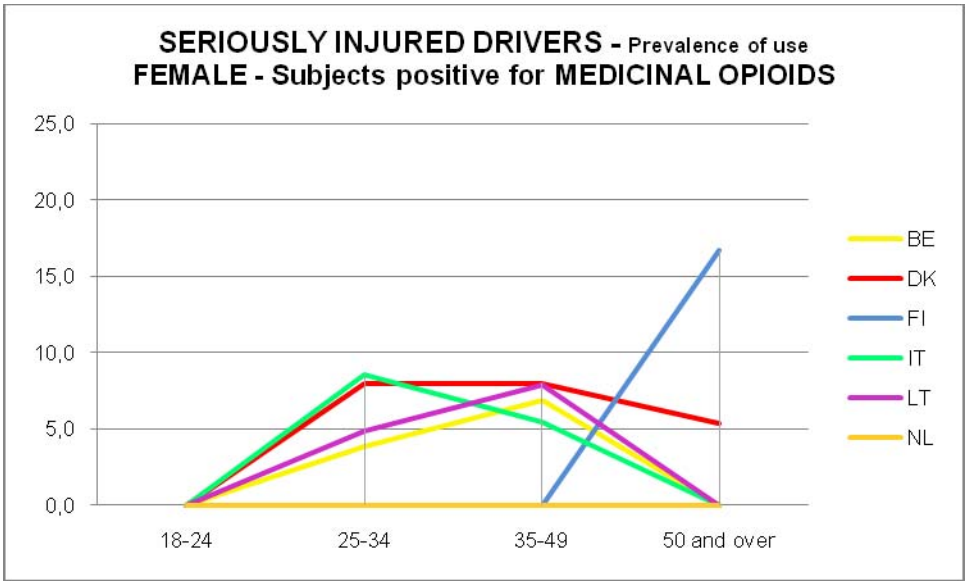


Figure 54. Prevalence of use – Medicinal opioids: female drivers

3.6 Prevalence of substance groups use among killed drivers

3.6.1 Killed drivers – Prevalence of use – Alcohol ≥ 0.1 g/L

Table 63. Prevalence of use – Alcohol

KILLED DRIVERS	FI (471)	NO (193)	PT (285)	SE (153)
Percentage of subjects positive for alcohol	31.4	25.4	44.9	19.0

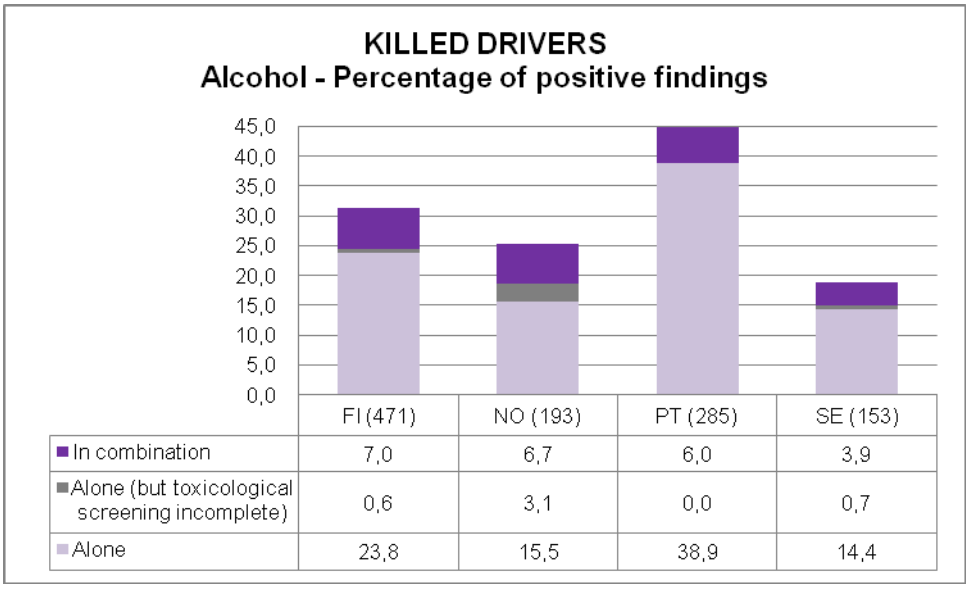


Figure 55. Prevalence of use – Alcohol: detail of toxicological findings

In the killed drivers alcohol (cut-off= 0.1 g/L) was generally found in percentages relatively similar to the ones observed among seriously injured drivers. Portugal had the highest percentage of positive findings (approximately 45%). Finland had the second highest percentage with a prevalence of 31.4, relatively similar to the one recorded in the seriously injured drivers.

More positive subjects were found in the male group compared to the females in all countries. Apart from Portugal, for which the trend appears to be opposite in the female group, the percentage of positive findings tends to drop in the older age group (50 and above). It has however to be noted that the number of female subjects was relatively low for all countries and a single positive subject in a single age group could lead to high percentage.

When found in combination, alcohol is normally associated with benzodiazepines and/or THC/THCCOOH.

It has to be noted that, due to post-mortem bacterial and fungal activity, alcohol may be both produced and consumed in a body, and the possibility that toxicological findings may have been partially affected by these phenomena cannot be completely excluded.

Table 64. Prevalence of use – Alcohol: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for ALCOHOL						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	51.0	45.3	42.0	15.3	N.A.	34.4
Norway	37.5	34.5	34.5	13.0	N.A.	28.9
Portugal	43.9	58.5	63.8	28.9	14.3	47.2
Sweden	26.7	35.7	22.7	14.0	N.A.	21.6
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	12.5	30.0	35.5	3.0	N.A.	18.9
Norway	12.5	12.5	23.1	0.0	N.A.	12.2
Portugal	0.0	16.7	12.5	50.0	N.A.	15.0
Sweden	75.0	25.0	0.0	0.0	N.A.	10.8

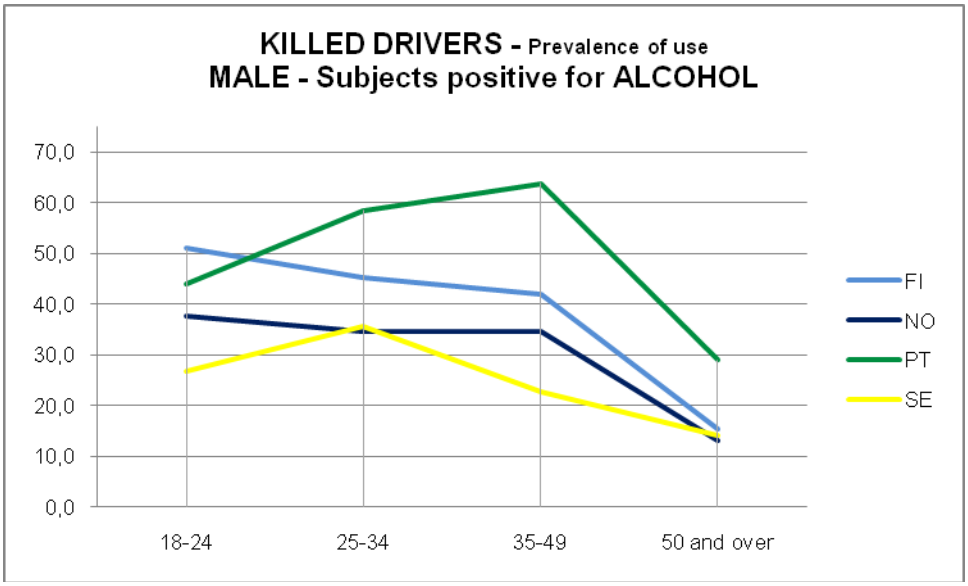


Figure 56. Prevalence of use – Alcohol: male drivers

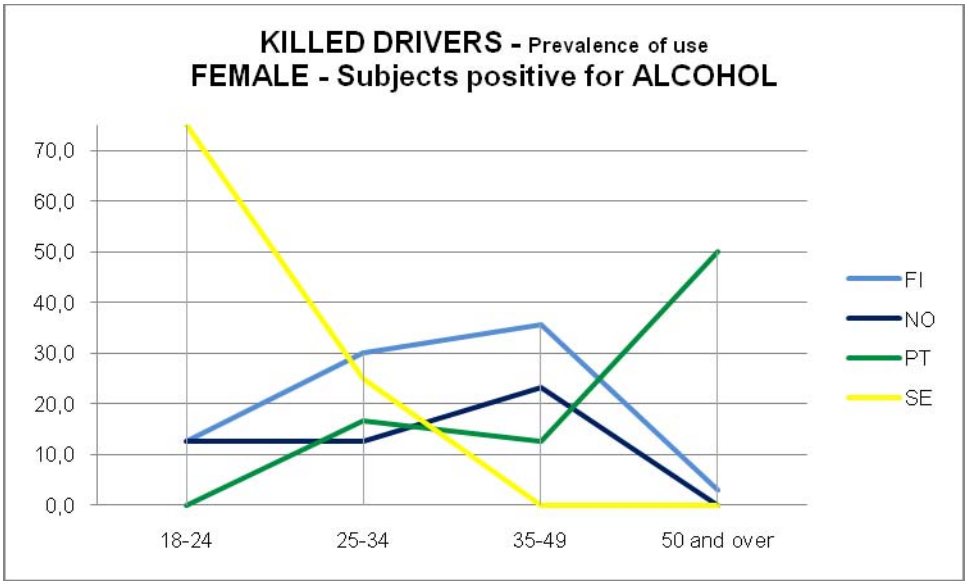


Figure 57. Prevalence of use – Alcohol: female drivers

3.6.2 Killed drivers – Prevalence of use – Alcohol (≥0.5 g/L)

Table 65. Prevalence of use- alcohol (≥0.5 g/L)

KILLED DRIVERS	FI (471)	NO (193)	PT (285)	SE (153)
Percentage of subjects tested positive for alcohol	29.3	23.8	35.1	16.3

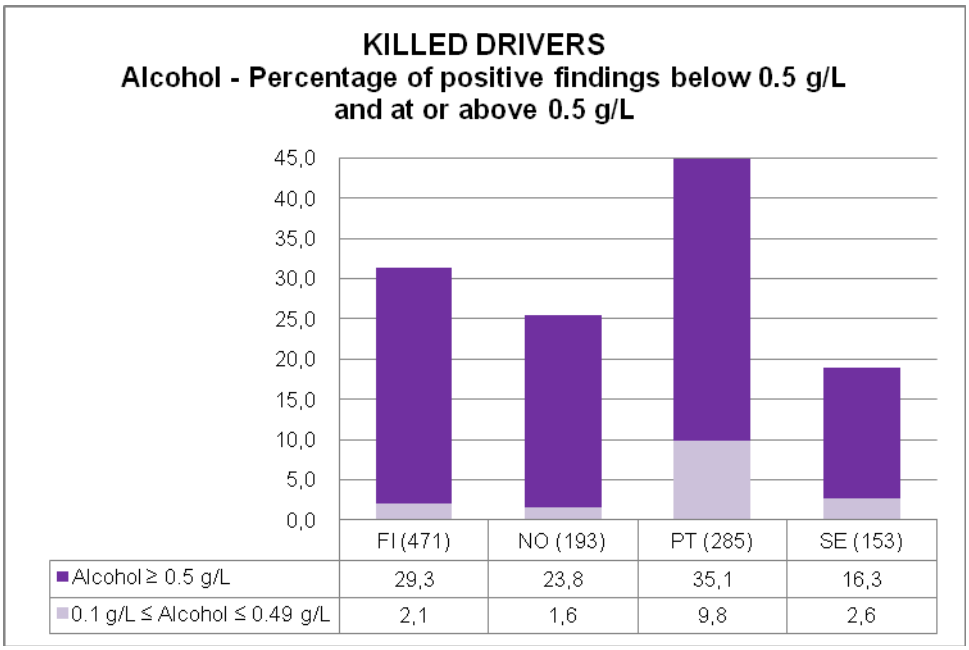


Figure 58. Prevalence of use – alcohol (≥0.5 g/L)

In the four countries participating in the killed drivers study, the percentage of positive drivers in which alcohol (cut-off ≥0.5 g/L) was found ranged between approximately 16 and 35. The percentage of drivers in which alcohol was found between 0.1 g/L-0.49 g/L ranged approximately between 1.5 and 10. Most positive drivers (alcohol ≥0.5 g/L) were found in Portugal (35.1%).

3.6.3 Killed drivers – Prevalence of use – Amphetamines

Table 66. Prevalence of use – Amphetamines

KILLED DRIVERS	FI (466)	NO (176)	PT (285)	SE (152)
Percentage of subjects positive for amphetamines	2.1	7.4	0.0	6.6

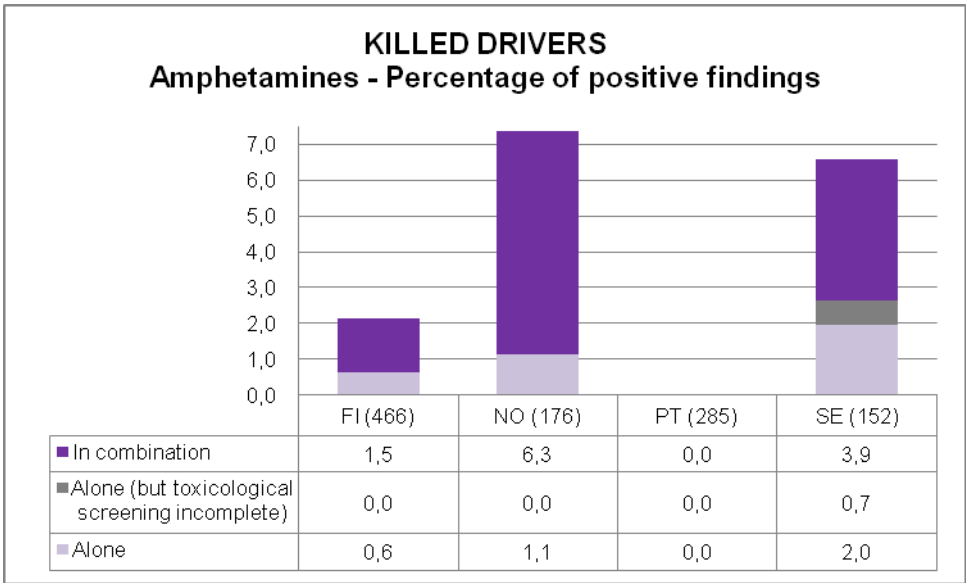


Figure 59. Prevalence of use – Amphetamines: detail of toxicological findings

In the killed drivers study subjects positive for the amphetamine group were found in all countries apart from Portugal. The highest percentage was found in Norway, which is also the only country that had one subject positive for amphetamines in the female group. In the male group the percentage of positive findings was relatively similar in Norway and Sweden.

Four subjects in the age group 50 and over that tested positive for the amphetamine group, three being positive for amphetamine, alone or combined with methadone and alcohol respectively, and one being positive for methamphetamine only.

In general amphetamines appear to be used with other drugs, being more often in combination with benzodiazepines and alcohol.

Table 67. Prevalence of use – Amphetamines: detail on gender and age groups

Prevalence of use - Percentage of subjects positive for AMPHETAMINES						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	4.1	1.6	5.8	0.7	N.A.	2.7
Norway	8.9	14.3	15.4	0.0	N.A.	8.5
Portugal	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	6.9	21.4	8.7	6.0	N.A.	8.6
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	8.3	0.0	N.A.	2.9
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

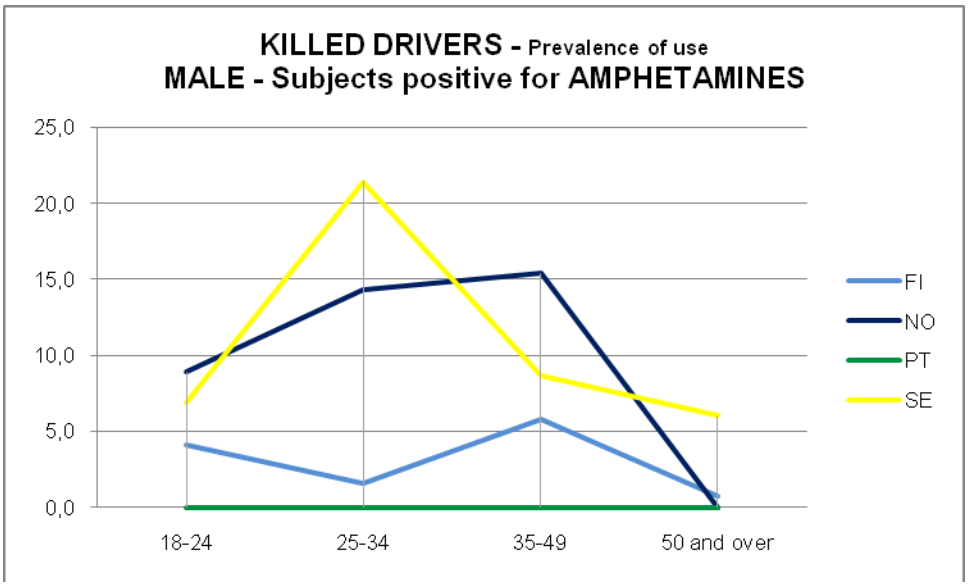


Figure 60. Prevalence of use – Amphetamines: male drivers

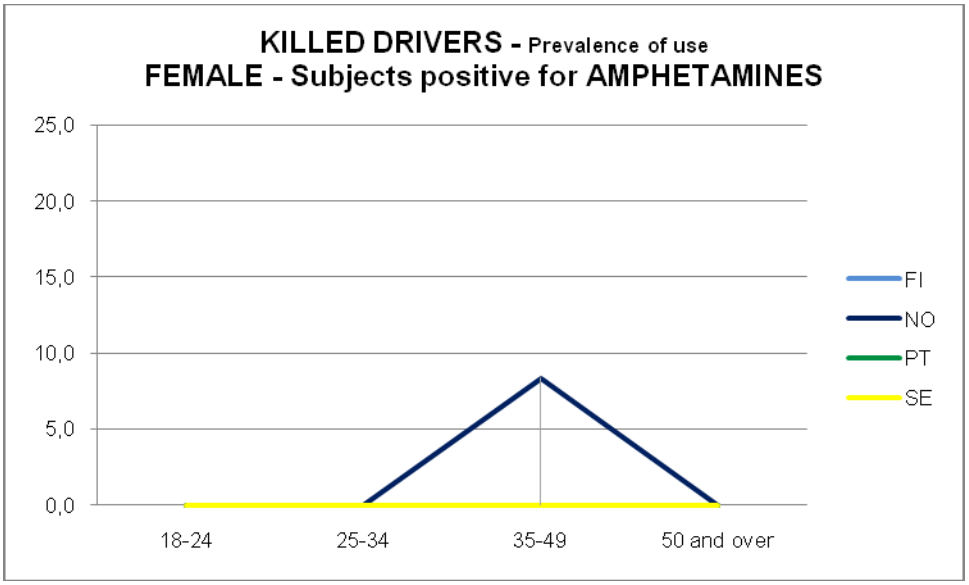


Figure 61. Prevalence of use – Amphetamines: female drivers

3.6.4 Killed drivers – Prevalence of use – Benzoylecgonine

As for the seriously injured drivers, data about benzoylecgonine and cocaine are presented in separate tables and graphs, because of the substance groups classification. However, as already mentioned, for a whole picture of the use of cocaine among the sampled sub-populations, the two sets of data should be considered together.

Table 68. Prevalence of use – Benzoylecgonine

KILLED DRIVERS	FI (466)	NO (171)	PT (285)	SE (152)
Percentage of subjects positive for benzoylecgonine (but negative for cocaine)	0.0	0.6	0.7	0.7

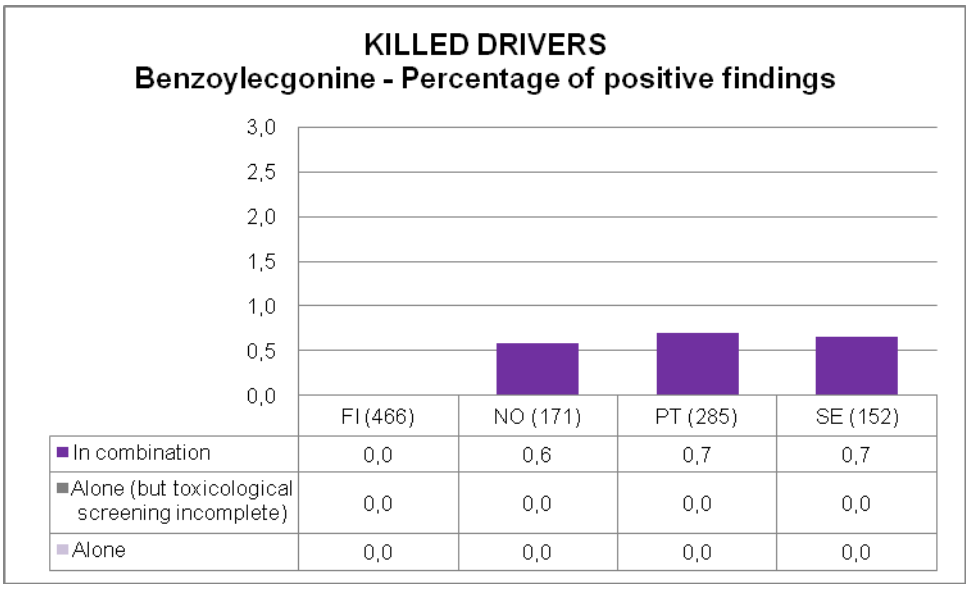


Figure 62. Prevalence of use – Benzoylecgonine: detail of toxicological findings

The number of cases positive for benzoylecgonine (without the presence of cocaine) is relatively low in the killed drivers subpopulations, with no positive findings in Finland. In the other three countries a total of four drivers tested positive for benzoylecgonine, with only one positive subject found both in Norway and Sweden and two in Portugal. All were males and part of either the age group 25-34 or 35-49.

Benzoylecgonine is always found in combination with other psychoactive substances, and in particular with alcohol in three cases and with amphetamines in one case.

Table 69. Prevalence of use – Benzoylecgonine: detail on gender and age groups

Prevalence of use - Percentage of drivers tested positive for BENZOYLECGONINE (without cocaine)						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	3.4	0.0	0.0	N.A.	0.7
Portugal	0.0	1.5	1.4	0.0	0.0	0.8
Sweden	0.0	7.1	0.0	0.0	N.A.	0.9
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

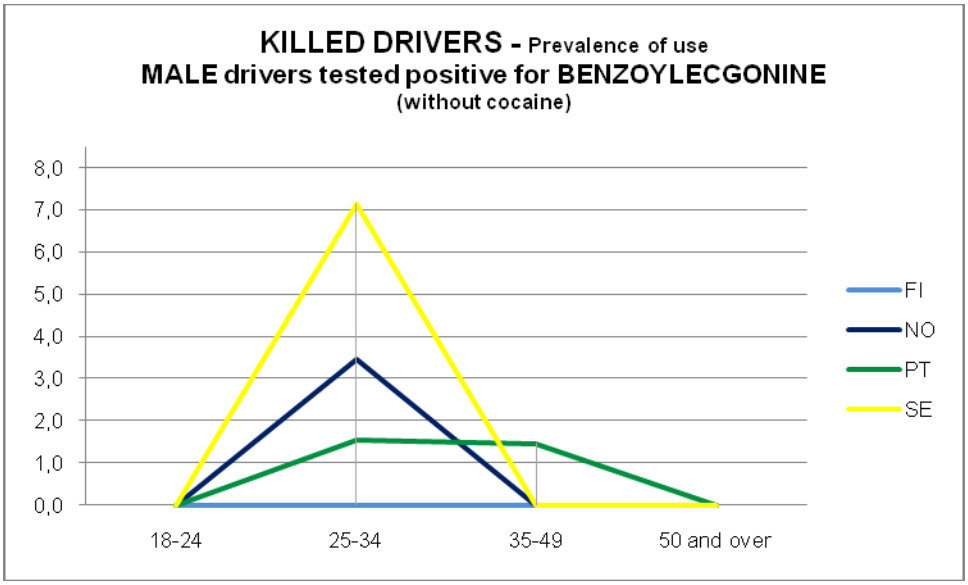


Figure 63. Prevalence of use – Benzoylecgonine: male drivers

3.6.5 Killed drivers – Prevalence of use – Cocaine

Table 70. Prevalence of use – Cocaine

KILLED DRIVERS	FI (466)	NO (179)	PT (285)	SE (152)
Percentage of subjects positive for cocaine	0.0	0.0	0.7	0.7

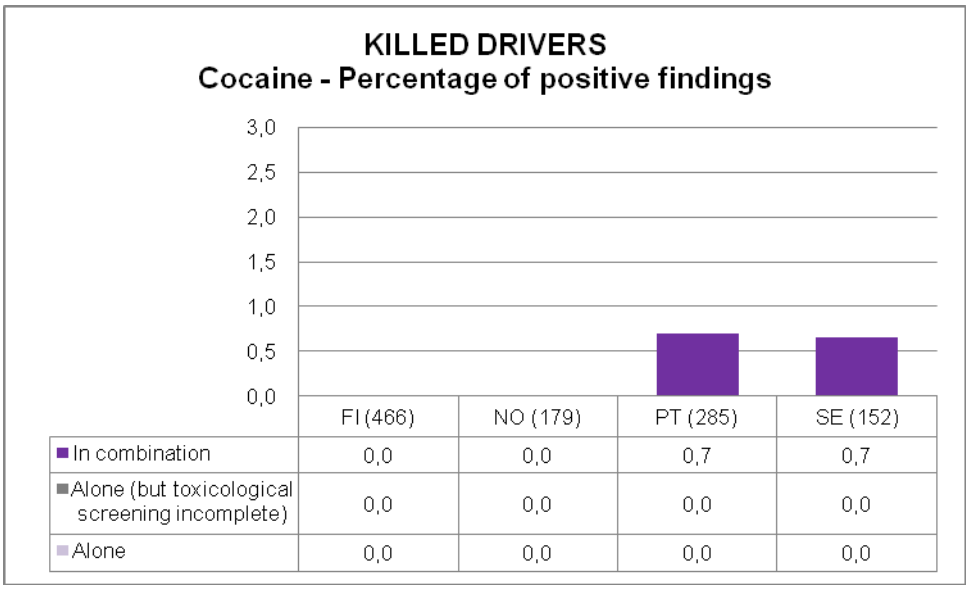


Figure 64. Prevalence of use – Cocaine: detail of toxicological findings

The number of positive findings for cocaine (alone or in the presence of benzoylecgonine) in the killed drivers subpopulations is small as in the case of benzoylecgonine. No driver tested positive for cocaine in Finland and Norway. Of the 3 positive subjects, two were

found in Portugal and one in Sweden. All were male, one being of the age group 18-24 and two of the age group 25-34.

As for benzoylecgonine, all findings for cocaine are in association, and all in association with alcohol.

Table 71. Prevalence of use – Cocaine: detail on gender and age groups

Prevalence of use - Percentage of drivers tested positive for COCAINE						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	2.4	1.5	0.0	0.0	0.0	0.8
Sweden	0.0	7.1	0.0	0.0	N.A.	0.9
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

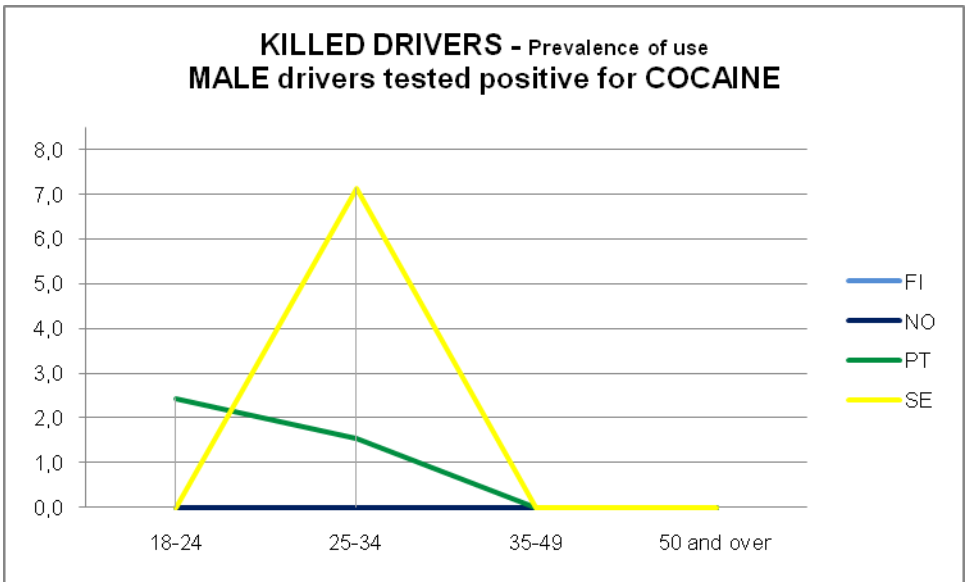


Figure 65. Prevalence of use – Cocaine: male drivers

3.6.6 Killed drivers – Prevalence of use – Cocaine and/or benzoylecgonine

When combined, data for cocaine and benzoylecgonine in the killed driver study show the highest percentage of positive cases in Portugal and Sweden. Only male subjects were found positive for cocaine and/or benzoylecgonine. As in the seriously injured drivers study, also in the killed drivers study no cases of cocaine/benzoyleconine were recorded in Finland.
All subjects positive for cocaine and/or benzoylecgonine tested positive also for another substance group, ethanol being the most commonly associated finding.

Table 72. Prevalence of use – Cocaine and/or benzoylecgonine

KILLED DRIVERS	FI (466)	NO (171)	PT (285)	SE (152)
Percentage of subjects tested positive for cocaine and/or benzoylecgonine	0.0	0.6	1.4	1.3

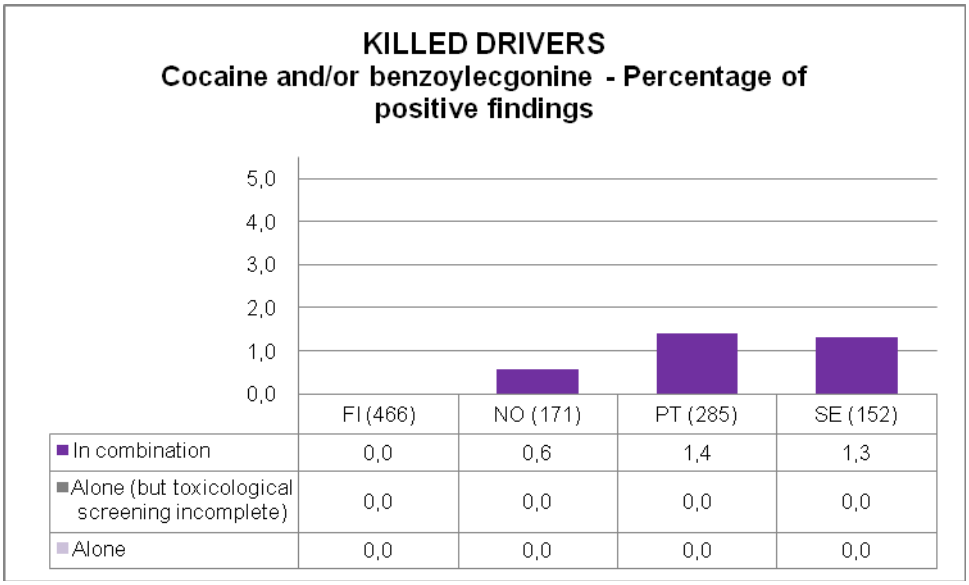


Figure 66. Prevalence of use – Cocaine and/or benzoylecgonine

Table 73. Prevalence of use – Cocaine and/or Benzoylecgonine : detail on gender and age groups

Prevalence of use - Percentage of drivers tested positive for COCAINE and/or Benzoylecgonine						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	3.4	0.0	0.0	N.A.	0.7
Portugal	2.4	3.1	1.4	0.0	0.0	1.5
Sweden	0.0	14.3	0.0	0.0	N.A.	1.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

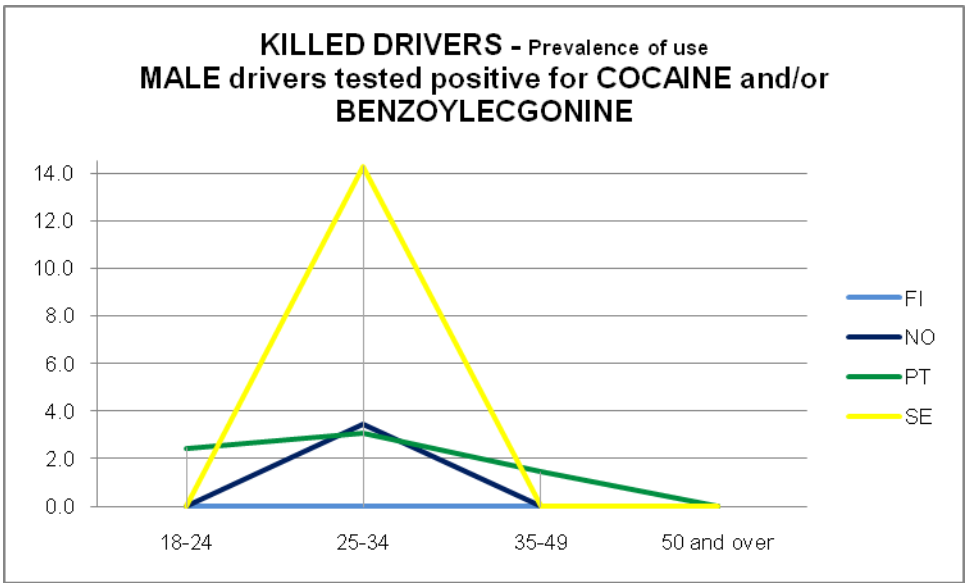


Figure 67. Prevalence of use – Cocaine and/or Benzoylecgonine : Male drivers

3.6.7 Killed drivers – Prevalence of use – THCCOOH

As already reported for the seriously injured drivers study, data about THCCOOH and THC are presented in separate tables and graphs, because of the substance groups classification. However, for a whole picture of the use of cannabis among the sampled subpopulations, the two sets of data should be considered together, being THCCOOH the break down product of THC in the body.

As Finland and Norway did not analyse for the presence of THCCOOH, prevalence of cannabis use in this countries might have been underestimated.

Table 74. Prevalence of use – THCCOOH

KILLED DRIVERS	FI (0)	NO (0)	PT (285)	SE (147)
Percentage of subjects positive for THCCOOH (but negative for THC)	N.A.	N.A.	4.2	0.0

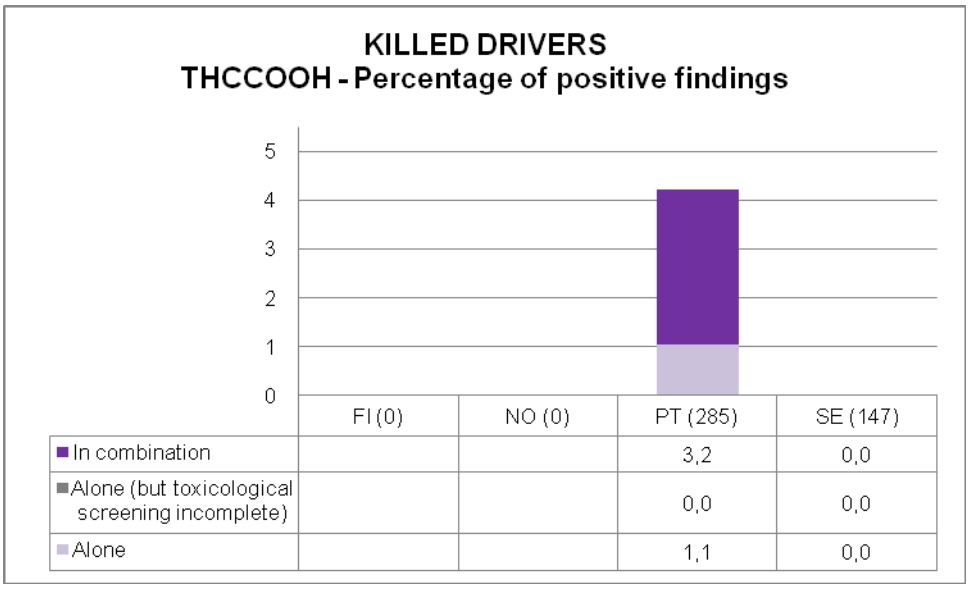


Figure 68. Prevalence of use – THCCOOH: detail of toxicological findings

Subjects positive for THCCOOH (without the presence of THC) were found in Portugal only. All positive drivers were found in the male group, with percentages that decrease as age increases. More than three quarters of the subjects tested positive also for another psychoactive substance, alcohol being the most common associated finding.

Table 75. Prevalence of use – THCCOOH: detail on gender and age groups

Prevalence of use - Percentage of drivers tested positive for THCCOOH (without THC)						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Norway	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Portugal	9.8	7.7	2.9	1.2	0.0	4.5
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Norway	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

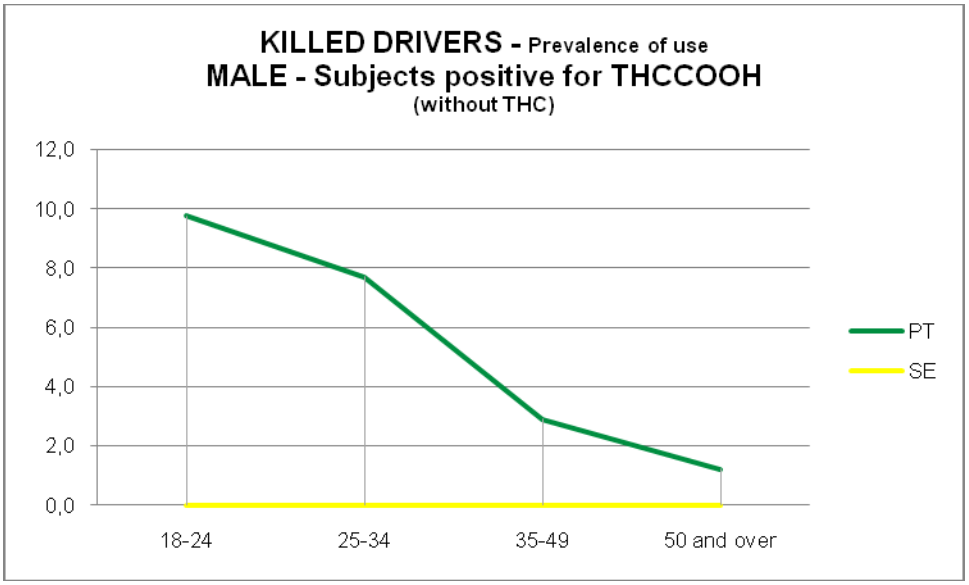


Figure 69. Prevalence of use – THCCOOH: male drivers

3.6.8 Killed drivers – Prevalence of use – THC

Table 76. Prevalence of use – THC

KILLED DRIVERS	FI (466)	NO (179)	PT (285)	SE (152)
Percentage of subjects positive for THC	1.3	6.1	0.0	1.3

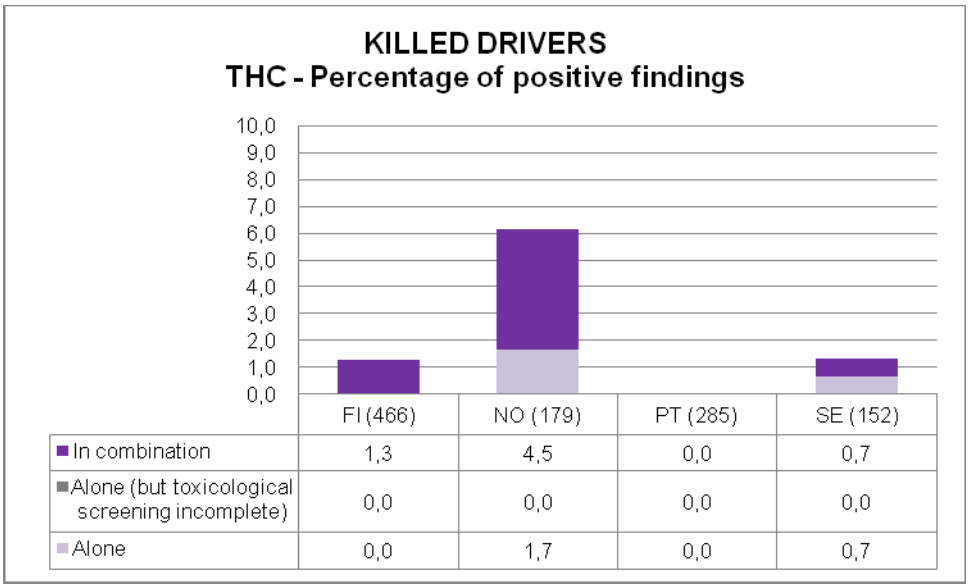


Figure 70. Prevalence of use – THC: detail of toxicological findings

Subjects positive for THC (alone or in the presence of THCCOOH) were found only in the male groups and only in the first three age groups up to 49 years. While there were no positive findings in Portugal, the highest percentage of positive cases was found in Norway. Sweden and Finland show a similar percentage (1.3% on the whole population).

In the majority of cases subjects positive for THC tested also positive for other psychoactive substances, alcohol, benzodiazepines and amphetamines being the most common associated findings.

Table 77. Prevalence of use – THC: detail on gender and age groups

Prevalence of use - Percentage of drivers tested positive for THC						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	1.0	1.6	5.8	0.0	N.A.	1.6
Norway	11.1	13.8	8.0	0.0	N.A.	7.7
Portugal	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	3.4	0.0	4.3	0.0	N.A.	1.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

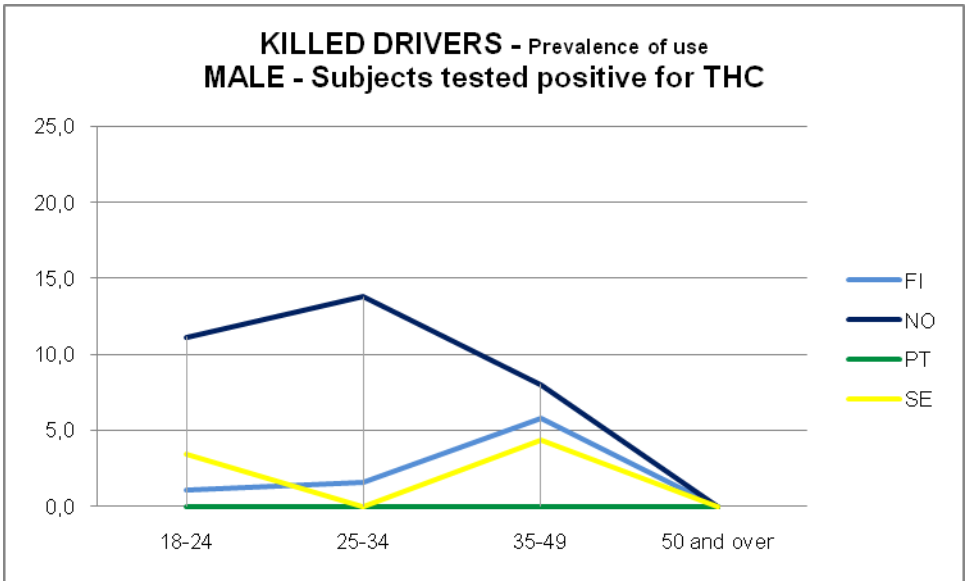


Figure 71. Prevalence of use – THC: male drivers

3.6.9 Killed drivers – Prevalence of use – THC and/or THCCOOH

In the killed drivers study, data on the prevalence of use of cannabis are partial for Finland and Norway, the samples not having been analysed for the presence of THCCOOH.

In general, however, Norway had the highest percentage of positive findings. In all four countries THC and/or THCCOOH were detected only in the male group, with only one case, positive for THCCOOH only, in the age group 50 and above, recorded in Portugal.

Cannabis use appears to be more often in combination with other psychoactive substances, with alcohol and benzodiazepines being the most commonly associated findings.

Table 78. Prevalence of use - THC and/or THCCOOH

KILLED DRIVERS	FI (466)	NO (179)	PT (285)	SE (147)
Percentage of subjects tested positive for THC and/or THCCOOH	1.3	6.1	4.2	1.4

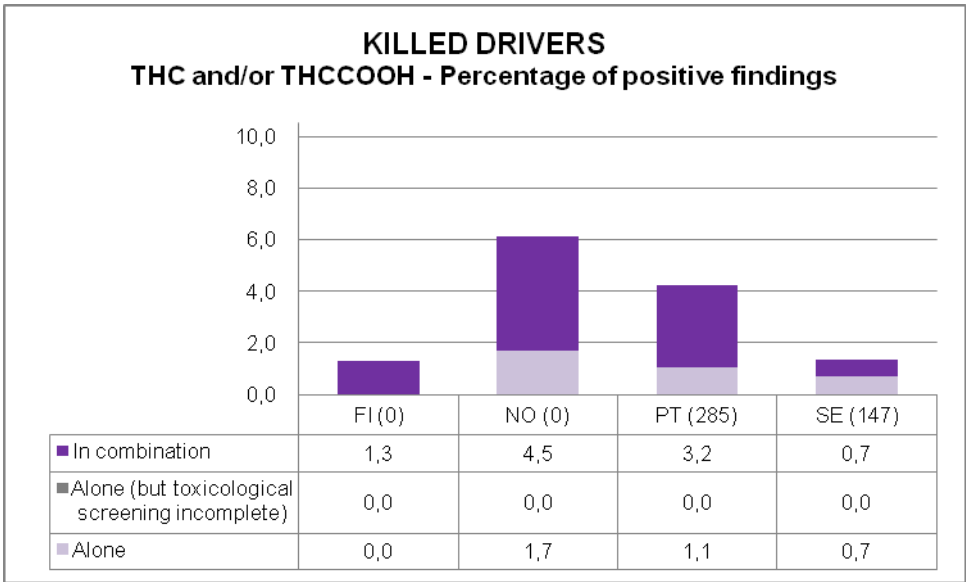


Figure 72. Prevalence of use - THC and/or THCCOOH

Table 79. Prevalence of use – THC and/or THCCOOH : detail gender and age groups

Prevalence of use - Percentage of drivers tested positive for THC and/or THCCOOH						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	1.0	1.6	5.8	0.0	N.A.	1.6
Norway	11.1	13.8	8.0	0.0	N.A.	7.7
Portugal	9.8	7.7	2.9	1.2	0.0	4.5
Sweden	3.7	0.0	4.5	0.0	N.A.	1.8
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

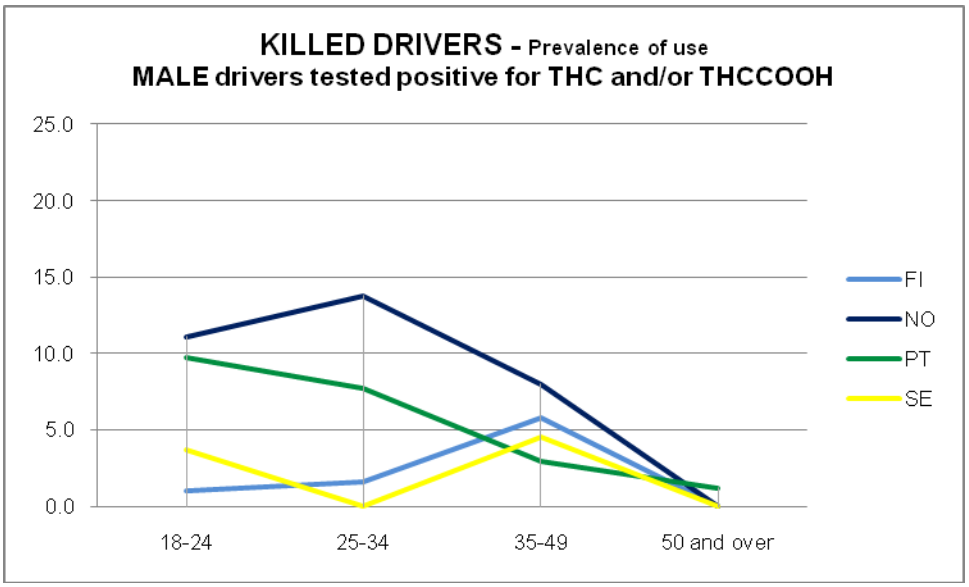


Figure 73. Prevalence of use – THC and/or THCCOOH : Male drivers

3.6.10 Killed drivers – Prevalence of use – Illicit opiates

Table 80. Prevalence of use – Illicit opiates

KILLED DRIVERS	FI (466)	NO (179)	PT (285)	SE (152)
Percentage of subjects positive for illicit opiates	0.0	0.0	0.0	0.0

No cases of illicit opiates use were recorded in the killed drivers subpopulations of the four countries participating in the study.

3.6.11 Killed drivers – Prevalence of use – Benzodiazepines

Table 81. Prevalence of use – Benzodiazepines

KILLED DRIVERS	FI (466)	NO (176)	PT (285)	SE (154)
Percentage of subjects positive for benzodiazepines	13.3	9.7	1.8	3.9

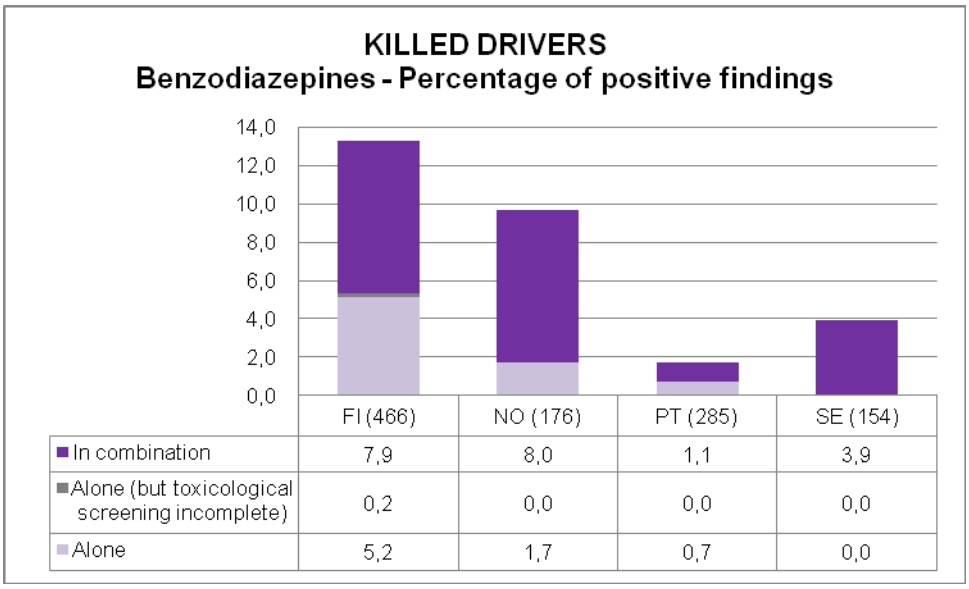


Figure 74. Prevalence of use – Benzodiazepines: detail of toxicological findings

As in the seriously injured drivers study, among the subpopulations of killed drivers, Finland had the highest percentage of subjects positive for benzodiazepines, followed by Norway and Sweden. In Portugal only 1.8% of the sampled subpopulation tested positive for benzodiazepines. In the male group the highest percentage of positive findings were recorded in the age groups 25-34 and 35-49. In Portugal and Sweden no subject tested positive for benzodiazepines in the female group. In Finland and Norway the highest percentage of female positive for benzodiazepines were recorded in the age group 50 and over.

It has however to be noted that, because of the low number of female subjects (17%) the results should be interpreted cautiously .

Benzodiazepines are more often found in association with other psychoactive substances than alone, the most common associated findings being alcohol, amphetamines, THC and/or THCCOOH and Z-drugs.

Table 82. Prevalence of use – Benzodiazepines: detail on gender and age groups

Prevalence of use - Percentage of drivers tested positive for BENZODIAZEPINES						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	3.1	21.9	23.2	11.6	N.A.	13.3
Norway	4.5	23.1	19.2	2.4	N.A.	10.1
Portugal	0.0	3.1	2.9	1.2	0.0	1.9
Sweden	3.3	14.3	4.3	3.9	N.A.	5.1
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	12.5	0.0	15.6	16.1	N.A.	13.5
Norway	12.5	0.0	0.0	20.0	N.A.	7.9
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

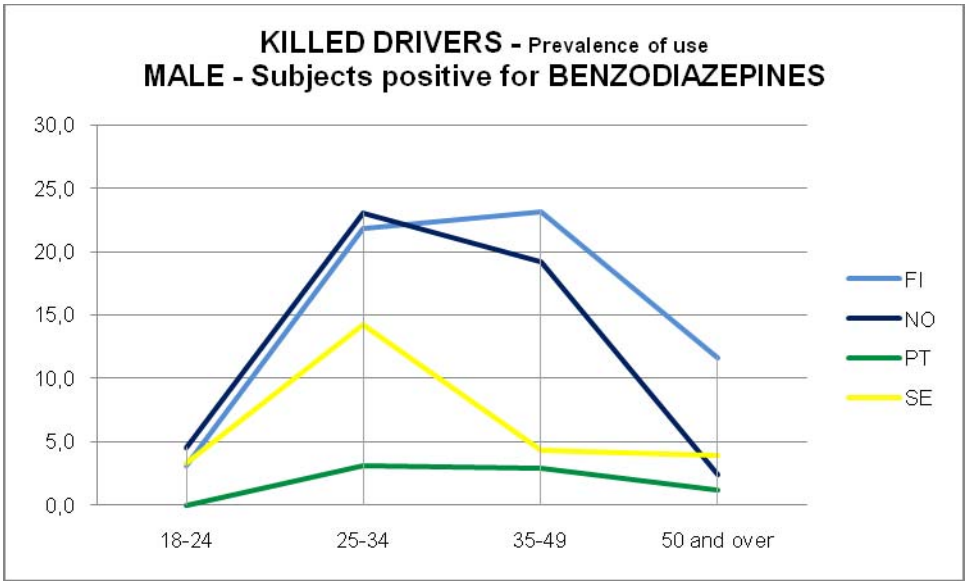


Figure 75. Prevalence of use – Benzodiazepines: male drivers

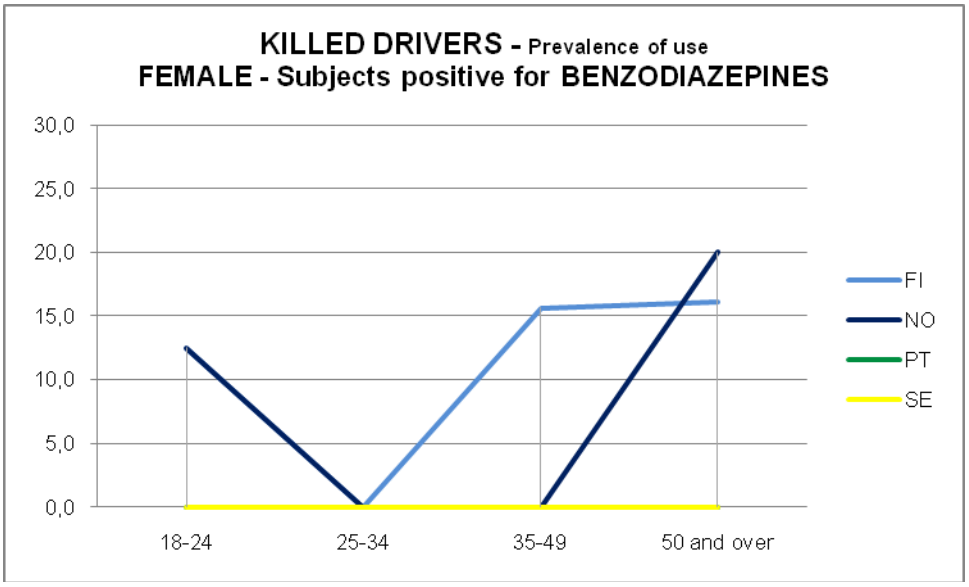


Figure 76. Prevalence of use – Benzodiazepines: female drivers

3.6.12 Killed drivers – Prevalence of use – Z-drugs

Table 83. Prevalence of use – Z-drugs

KILLED DRIVERS	FI (466)	NO (182)	PT (285)	SE (154)
Percentage of subjects positive for Z-drugs	3.0	4.4	0.0	3.2

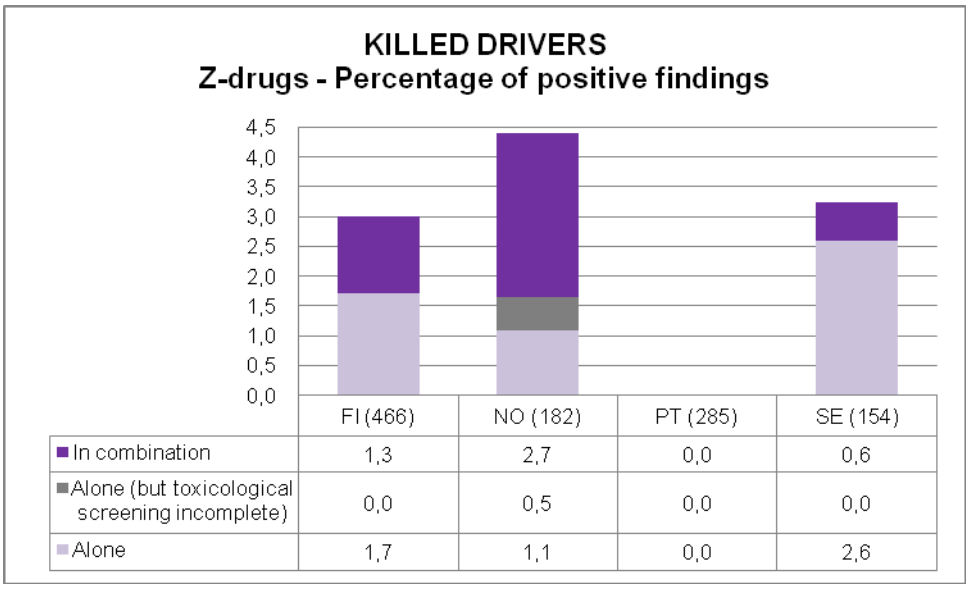


Figure 77. Prevalence of use – Z-drugs: detail of toxicological findings

The highest percentage of subjects positive for Z-drugs was found in Norway, followed by Sweden and Finland. No subject tested positive in Portugal. Percentage of positives appeared to be generally higher in the older age groups (35-49 and 50 and above). In approximately half of the cases Z-drugs were found in combination with other substances, benzodiazepines and alcohol being the most commonly associated findings.

Table 84. Prevalence of use – Z-drugs: detail on gender and age groups

Prevalence of use - Percentage of drivers tested positive for Z-DRUGS						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	1.0	1.6	1.4	7.5	N.A.	3.7
Norway	0.0	0.0	7.4	6.8	N.A.	3.5
Portugal	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	0.0	0.0	4.3	5.9	N.A.	3.4
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	12.5	0.0	0.0	20.0	N.A.	7.9
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	9.1	0.0	N.A.	2.8

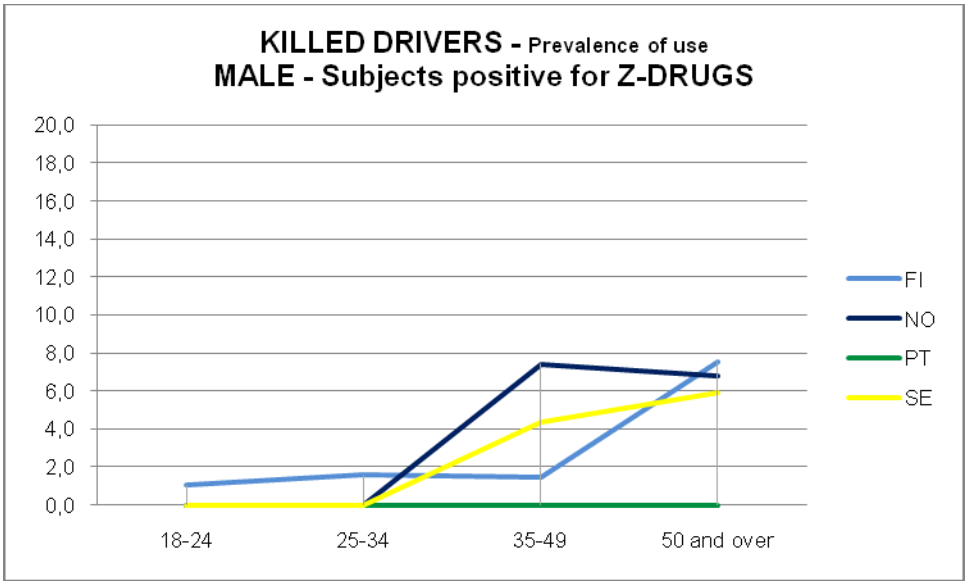


Figure 78. Prevalence of use – Z-drugs: male drivers

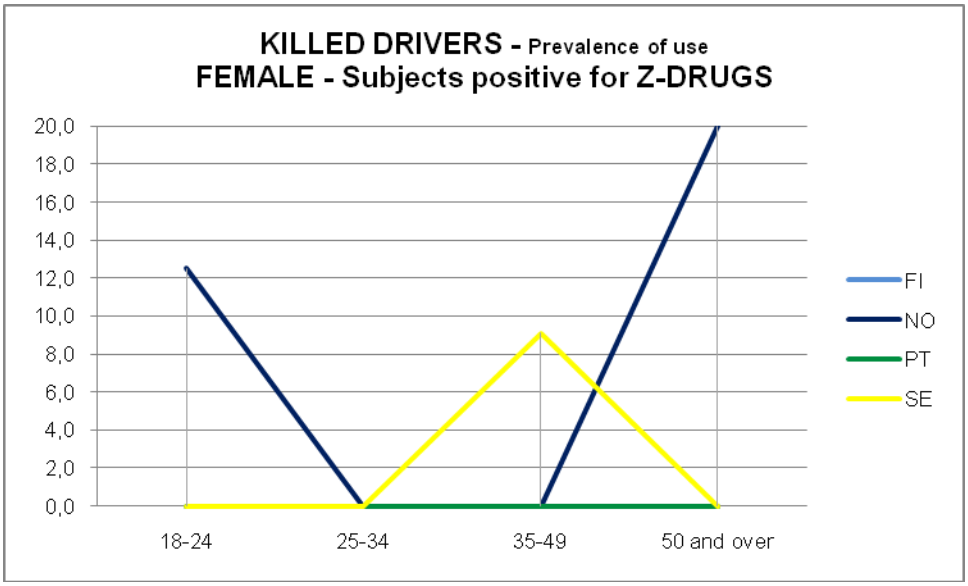


Figure 79. Prevalence of use – Z-drugs: female drivers

3.6.13 Killed drivers – Prevalence of use – Medicinal opioids

Table 85. Prevalence of use – Medicinal opioids

KILLED DRIVERS	FI (466)	NO (177)	PT (252)	SE (146)
Percentage of subjects positive for medicinal opioids	2.1	1.7	2.1	4.1

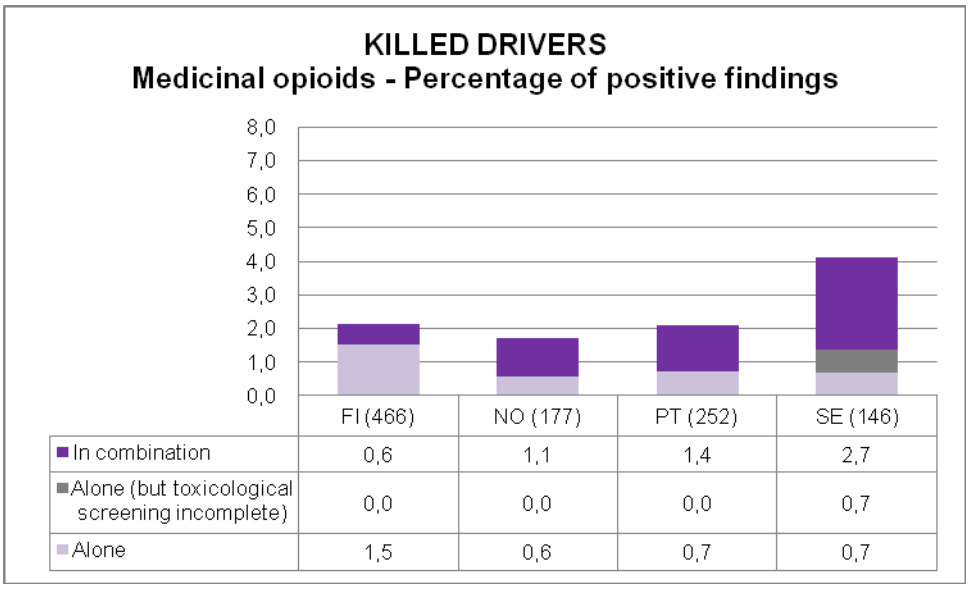


Figure 80. Prevalence of use – Medicinal opioids: detail of toxicological findings

The highest percentage of subjects positive for medicinal opioids was recorded in Sweden. This is approximately double of when compared to the ones recorded in the other countries. With different patterns in the 4 countries, subjects positive for medicinal opioids were present in both gender and in all age groups, with higher percentages in the male group aged 50 and over. Apart from Finland, where the majority of the cases of medicinal opioids appeared alone, in the other three countries medicinal opioids appeared in higher percentage in combination with other psychoactive substances, benzodiazepines and alcohol being the most commonly associated findings.

Table 86. Prevalence of use – Medicinal opioids: detail on gender and age groups

Prevalence of use - Percentage of drivers tested positive for MEDICINAL OPIOIDS						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	1.0	0.0	4.3	3.4	N.A.	2.4
Norway	0.0	0.0	0.0	2.4	N.A.	0.7
Portugal	0.0	6.2	1.4	1.2	0.0	2.3
Sweden	0.0	7.7	0.0	8.3	N.A.	4.5
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	3.2	N.A.	1.1
Norway	12.5	0.0	8.3	0.0	N.A.	5.4
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	25.0	0.0	0.0	N.A.	2.9

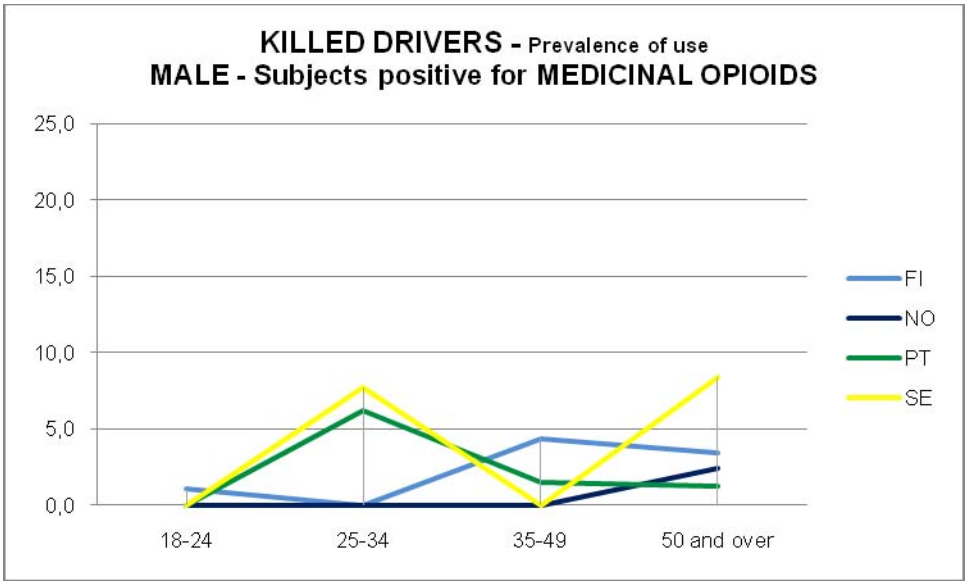


Figure 81. Prevalence of use – Medicinal opioids: male drivers

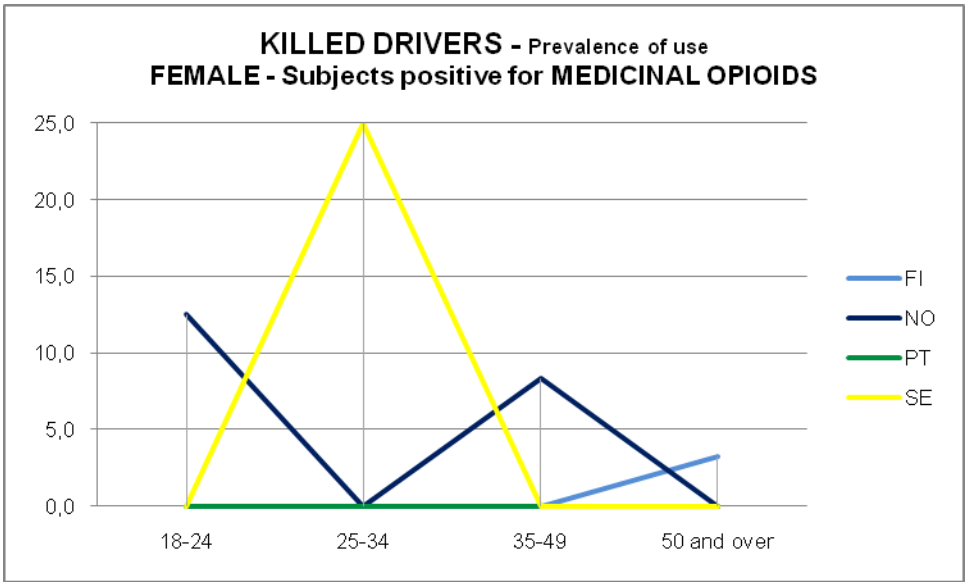


Figure 82. Prevalence of use – Medicinal opioids: female drivers

3.7 Seriously injured drivers – Distribution of positive drivers – Mutually exclusive groups

3.7.1 Distribution of positive drivers

Table 87. Seriously injured drivers – Distribution of positive drivers

MUTUALLY EXCLUSIVE GROUPS						
Toxicological finding	**BE**	**DK**	**FI**	**IT**	**LT**	**NL**
Negative	47.4	69.7	55.3	68.0	72.2	66.1
Positive	52.6	30.3	44.7	32.0	27.8	33.9

In the mutually exclusive groups, the highest percentage of positive drivers was found in Belgium, followed by Finland. In the other four countries participating in the seriously injured drivers study, the percentage of positive drivers is approximately in the range of 30%, Lithuania being the country with the lowest percentage (27.8). In Belgium, more than half of the drivers were positive.

3.7.2 Distribution of positive drivers by age and gender

The distribution by gender and age showed a higher percentage of positive drivers among the male group in all six countries. This happened almost in all age groups, with the exception of Finland, for which a higher percentage of positive subjects was present in the female group aged 18-24 compared to the same male group, and Lithuania, for which a slightly higher percentage of positive drivers was found in the female group aged 35-49 compared to the same male group.

The male group aged 25-34 was the one with the highest percentage of drivers testing positive for alcohol or drugs. This was the case of all the countries apart from Lithuania, where the highest percentage of positive male drivers was found in the age group 50 and above. With the exception of Lithuania, the percentage of positive drivers tend to decrease with increasing age in the age groups 35-49 and 50 and over.
In the female groups, the percentage of subjects positive for one of the mutually exclusive groups tended to fluctuate more across different age groups and in different countries. In Finland, female subjects testing positive for one of the mutually exclusive groups were found only in the age group 18-24.

Table 88. Seriously injured drivers – Distribution of positive drivers by age and gender

Mutually exclusive group - Percentage of positive drivers						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	61.2	66.2	60.0	40.9	75.0	59.3
Denmark	33.5	47.1	39.2	31.5	100.0	38.1
Finland	50.0	60.0	57.1	37.5	N.A.	51.4
Italy	38.0	42.2	34.9	19.1	N.A.	34.4
Lithuania	33.3	32.7	28.8	35.7	33.3	32.4
The Netherlands	32.0	59.0	35.3	26.9	N.A.	38.9
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	35.3	26.9	48.1	30.0	75.0	37.2
Denmark	6.3	23.8	14.9	19.6	40.0	15.8
Finland	66.7	0.0	0.0	0.0	N.A.	20.0
Italy	19.2	34.0	18.2	21.4	N.A.	23.7
Lithuania	25.0	19.5	28.9	0.0	0.0	20.9
The Netherlands	0.0	25.0	9.1	11.1	N.A.	13.5
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	25.0	15.4

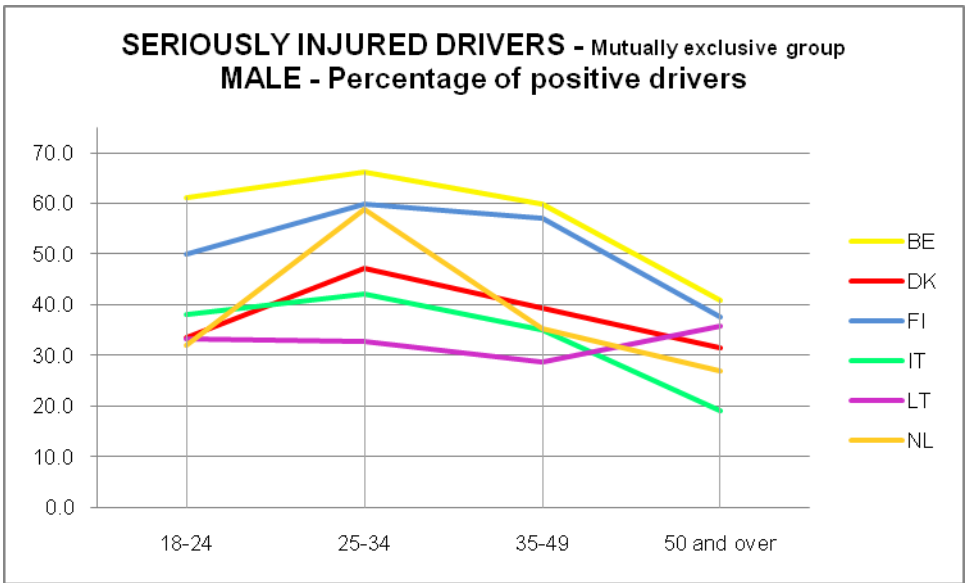


Figure 83. Mutually exclusive groups – Percentage of positive drivers: male

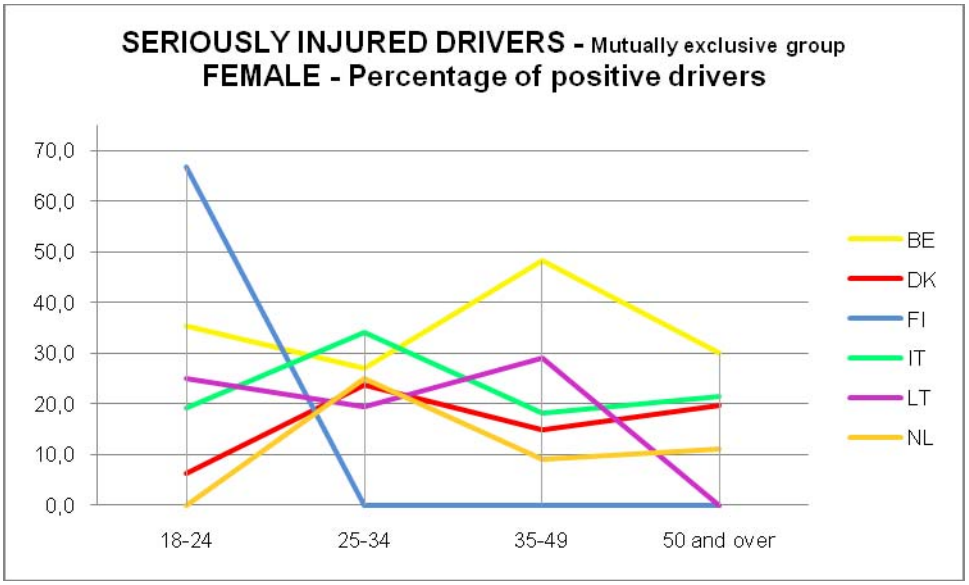


Figure 84. Mutually exclusive groups – Percentage of positive drivers: female

3.7.3 Distribution of positive drivers by substance groups

Table 89. Seriously injured drivers – Distribution of positive drivers by substance groups

MUTUALLY EXCLUSIVE GROUPS - Distribution of drivers by substance groups						
Toxicological finding	**BE**	**DK**	**FI**	**IT**	**LT**	**NL**
Negative	47.4	69.7	55.3	68.0	72.2	66.1
Alcohol only	30.2	14.1	25.5	18.5	15.3	25.3
Amphetamine only	0.9	1.0	0.0	0.0	0.3	1.1
Benzoylecgonine only (Cocaine/1)	0.0	0.0	0.0	0.7	0.3	1.1
Cocaine (Cocaine/2)	0.0	0.0	0.0	0.6	0.3	0.0
THCCOOH only (Cannabis/1)	0.6	1.6	0.0	0.4	0.3	0.0
THC (Cannabis/2)	1.5	0.6	2.1	1.6	0.3	0.5
Illicit opiates only	0.0	0.0	0.0	0.7	0.0	0.0
Benzodiazepines only	1.5	1.2	0.0	0.4	2.3	0.0
Z-drugs only	0.9	0.5	2.1	0.0	0.0	0.5
Medicinal opioids only	1.2	2.5	0.0	1.8	5.7	0.5
Alcohol + drug combination	13.2	5.4	10.6	4.6	2.3	4.3
Drug + drug combination	2.5	3.5	4.3	2.5	0.8	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

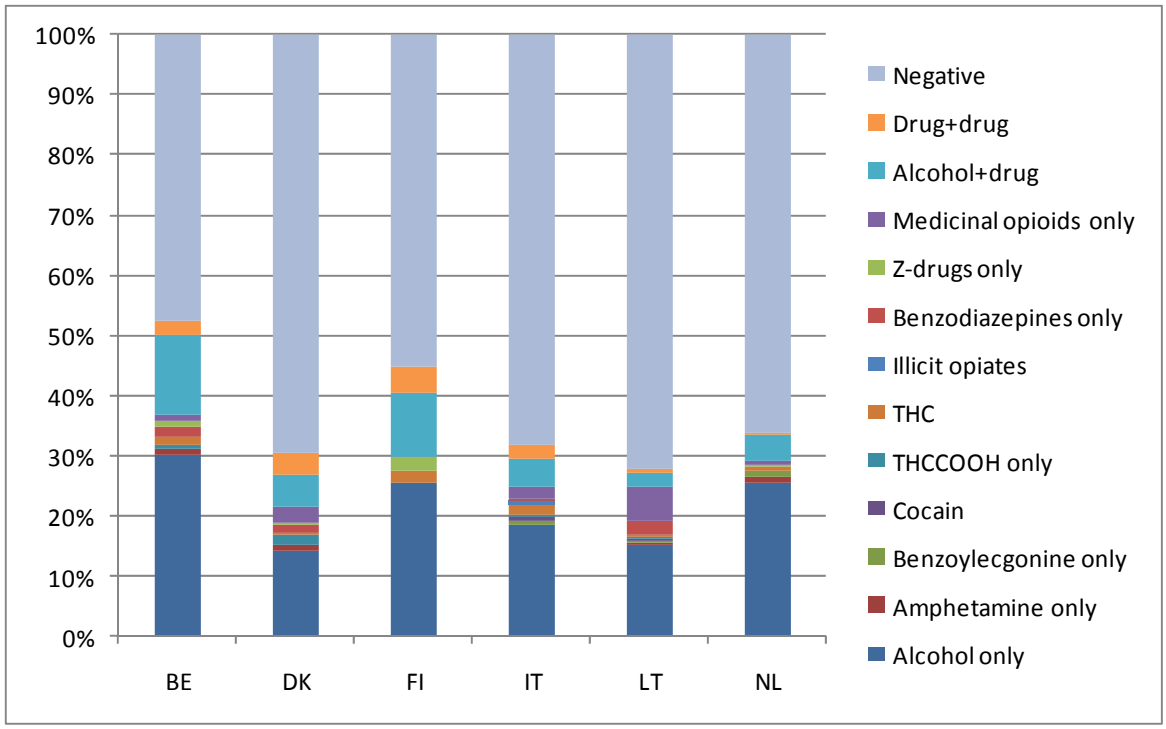


Figure 85. Seriously injured drivers – Distribution of positive drivers by substance groups

In the distribution of positive drivers by substance groups, subjects testing positive for "alcohol only" represent the largest group across all six countries. The group of subjects testing positive for an "alcohol-drug" combination is the second most represented in all countries apart from Lithuania, where a higher percentage of subjects is found in the "medicinal opioids" group. The group "drug-drug" represent either the third (Belgium, Denmark, Finland, Italy) or the fourth (Lithuania, The Netherlands) biggest group for percentage of positive subjects.

3.7.4 Distribution of positive drivers by amount of different substance groups taken

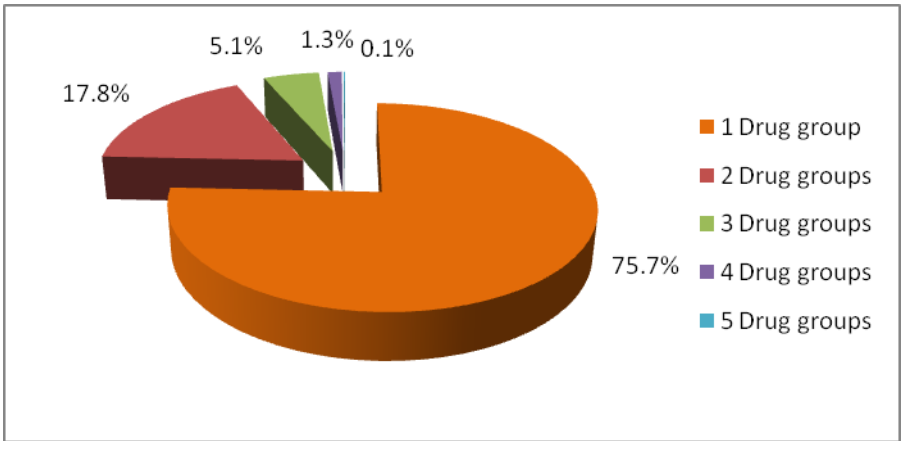


Figure 86. Seriously injured drivers - General distribution by number of drug groups taken

In general of the drivers tested positive for one or more substances, 75.7% used a single drug and 17.8% tested positive for 2 substance groups. In this distribution 'drug group' is defined as the substance groups classified in table 14 (2.3 data analysis) with cases positive for alcohol also categorized as a drug-positive.

Table 90. Seriously injured drivers – Distribution by country of number of different drug groups taken

Drug groups	Country					
	Belgium	Denmark	Finland	Italy	Lithuania	The Netherlands
1	120(69.8%)	178 (70.6%)	14 (66.7%)	168 (77.8%)	95 (88.8%)	54 (85.7%)
2	40 (23.3%)	43 (17.1%)	6 (28.6%)	40 (18.5%)	11 (10.3%)	8 (1.3%)
3	10 (5.8%)	21 (8.3%)	1 (4.8%)	8 (3.7%)	1 (0.9%)	1 (1.6%)
4	2 (1.2%)	9 (3.6%)	0	0	0	0
5	0	1 (0.4%)	0	0	0	0
Total	172(100%)	252 (100%)	21 (100%)	216(100%)	107 (100%)	63(100%)

Only one Danish person was found to have taken a combination of 5 substances. Combinations up to 3 different substance groups are seen in all countries involved in the seriously injured driver study. Only Belgium and Denmark had subjects tested positive for 4 different substance groups.
Because of the low number in some of the variables, a chi-square test could only be calculated for the first two categories, and disregarding the Finnish data. A significant difference was found between the countries for these substance group combinations ($p=0.03$). The single drug use was found in a higher percentage in Lithuania and the Netherlands, resulting also in a lower percentage of substance group combinations in these countries.

3.7.5 Distribution of substance groups by gender and age

Detailed distribution of substance groups by gender and age for each single country can be found in annex in the form of tables. Main findings have been summarised here below. Only for the "alcohol only", "alcohol-drug" and "drug-drug" groups data are presented herein in the form of table and/or graphs, which show the pattern of positive subjects in the male and female drivers by age groups.

The distribution of drivers positive for **alcohol only** shows a higher percentage among the male group in all countries. This happens for all age categories with the exception of Finland where the female group aged 18-24 shows a higher percentage of positive drivers compared to the one found in the same male age group. This is probably due to the small numbers of drivers included in the female group.

Table 91. Seriously injured drivers – Distribution of positive drivers – Alcohol only

Mutually exclusive group – Percentage of drivers positive for ALCOHOL ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	32.7	37.8	41.8	27.3	12.5	34.6
Denmark	17.8	24.3	19.2	14.6	100.0	19.4
Finland	41.7	10.0	42.9	12.5	N.A.	27.0
Italy	21.0	23.0	17.4	17.3	N.A.	19.8
Lithuania	22.7	17.3	13.6	11.9	16.7	16.8
The Netherlands	26.0	41.0	26.5	23.1	N.A.	29.5
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	17.6	19.2	22.2	15.0	25.0	19.1
Denmark	1.3	7.9	2.3	7.1	0.0	4.1
Finland	66.7	0.0	0.0	0.0	N.A.	20.0
Italy	19.2	14.9	12.7	10.7	N.A.	14.1
Lithuania	22.2	9.8	18.4	0.0	0.0	14.2
The Netherlands	0.0	8.3	9.1	11.1	N.A.	8.1
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

Few subjects tested positive for **amphetamines only**. In the male subgroup the highest percentage of positive findings was in Denmark (1.3%) followed by Belgium, The Netherlands and Lithuania (0.4%). In the female group positive subjects wer found in The Netherlands (2.7%), Belgium and Denmark (0.3%) only. No positive findings in both gender groups were recorded in Finland and Italy (Table 114, annex 2).

Among males, the highest prevalence for the **benzoylecgonine only** group was found in the Netherlands (1.3%), while no positive findings were recorded in Belgium, Denmark and Finland. For the female group only Italy had positive findings (0.6%). (Table 115, annex 2)

Regarding the distribution of the **cocaine only** group no positive drivers were found in the female subgroup. For the male group “cocaine only” was found in Italy in the age group 25-34 (0.6%) and 35-49 (2.0) and in Lithuania in the age group 50 and over (2.4%). The highest prevalence among all male subjects was found in Italy (0.8%) (Table 116, annex 2).

Positive findings for **THCCOOH only** in the male group and in all age group were found in Denmark (2.0%) and Belgium (0.9%). In the female group positive cases for THCCOOH were found only in Denmark (0.7%). (Table 117, annex 2).

For the **THC only** (with or without THCCOOH) group there were positive cases in the male group in all countries with the highest prevalence found in Finland (2.7%) followed by Italy (1.9%) and Belgium (1.7%). All countries had positive findings. In the female group positive cases were only recorded in Belgium (1.1%), in Italy (0.6%) and Denmark (0.3%). There were no positive findings for Finland, Lithuania and The Netherlands in the female group (Table 118, annex 2).

Only Italy had drivers that tested positive for **illicit opiates only**, with 0.8% of positive cases among male and 0.6% among female. (Table 119 in annex 2).

For the **benzodiazepines only** group, the highest percentage in the male group was found in Lithuania (2.5%). Belgium and Denmark were the only two other countries in which male subjects tested positive for benzodiazepines only (0.9% in both countries). In the female subpopulations cases positives for benzodiazepines only were recorded in four countries: Belgium (3.2%), Lithuania (2.2%), Italy (1.9%) and Denmark (1.7%). (Table 120, annex 2).

For the **Z-drug only** group positive male subjects were found only in Finland (2.7%), the Netherlands (0.7%) and Denmark (0.7%), while in the female group there were positive findings only in Belgium (3.2%) and Denmark (0.7%). (Table 121, annex 2).

Apart from Finland, all countries had positive findings for **medicinal opioids only** in the male group. The highest prevalence was recorded in Lithuania (7.6%). Finland and The Netherlands had no positive findings for medicinal opioids only in the female group. In the other countries the percentage of positives in the female group ranged from 3.4 in Denmark to 2.1 in Belgium. (Table 122, annex 2).

Among all male subjects Belgium had the highest prevalence of drivers positive for **alcohol-drug combination** (16.1%), followed by Finland (13.5%). Also among all female subjects Belgium had the highest prevalence of drivers positive for alcohol-drug combination (6.4%), followed by Italy (2.6%).

Table 92. Seriously injured drivers – Distribution of positive drivers – Alcohol-Drug combinations

Mutually exclusive group - Percentage of drivers positive for ALCOHOL-DRUG combination						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	24.5	14.9	14.5	4.5	50.0	16.1
Denmark	7.0	12.1	6.4	3.4	0.0	7.6
Finland	0.0	40.0	0.0	12.5	N.A.	13.5
Italy	3.0	8.1	6.7	0.9	N.A.	5.2
Lithuania	0.0	3.8	4.5	0.0	8.3	2.5
The Netherlands	6.0	10.3	0.0	0.0	N.A.	4.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	5.9	0.0	11.1	5.0	25.0	6.4
Denmark	0.0	1.6	2.3	1.8	0.0	1.4
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	4.3	1.8	3.6	N.A.	2.6
Lithuania	0.0	2.4	5.3	0.0	0.0	2.2
The Netherlands	0.0	8.3	0.0	0.0	N.A.	2.7
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

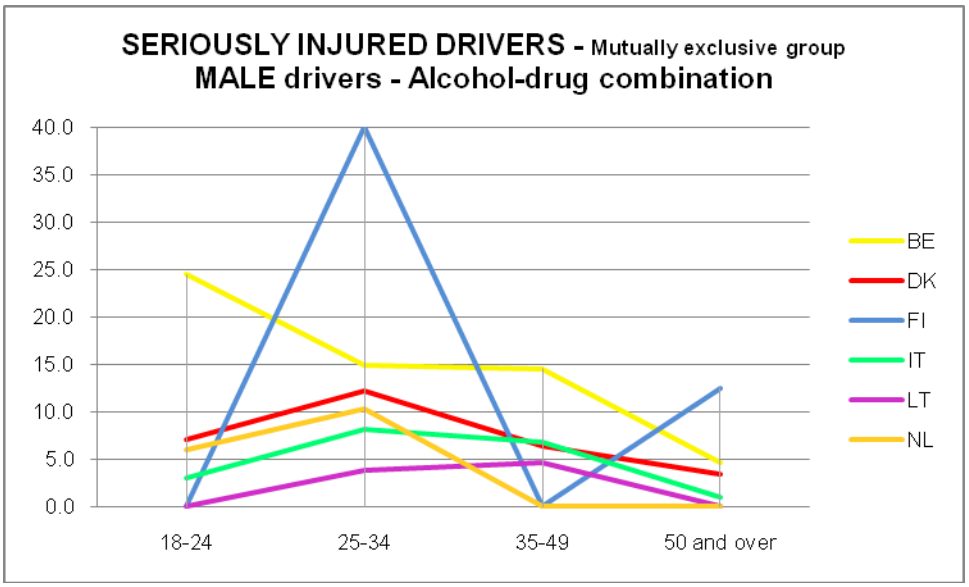


Figure 87. Mutually exclusive groups – Alcohol-drug combination: male drivers

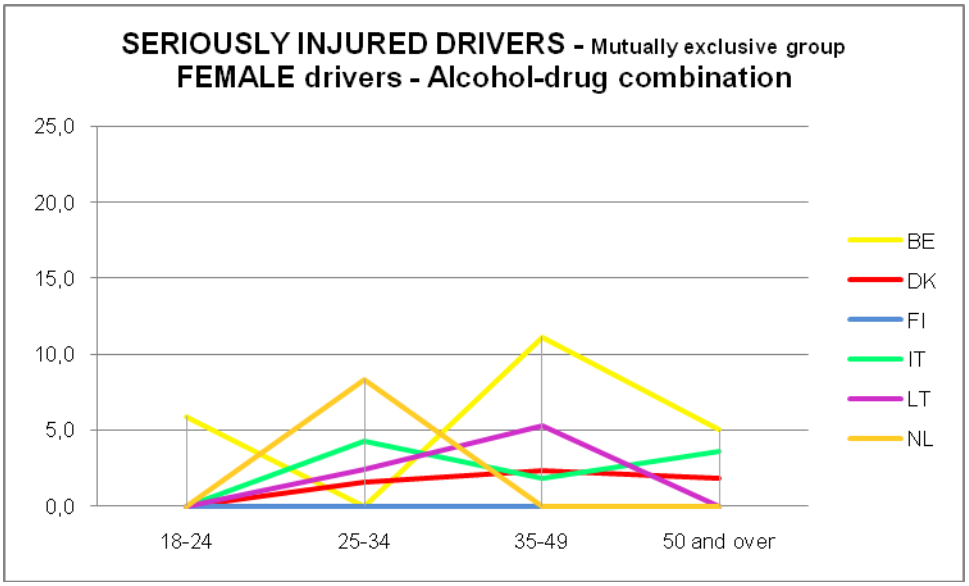


Figure 88. Mutually exclusive groups – Alcohol-drug combination: female drivers

All countries had drivers testing positive for drug-drug combinations. Finland had the highest percentage of drivers positive for drug-drug combinations in the male group (5.4% among all males). The Netherlands had the lowest percentage (1.3% among all male subjects).

In the female group only Belgium and Denmark had positive findings for drug-drug combinations. The highest prevalence for both countries was found in the age group 25-34, with a prevalence of 3.8% in Belgium and 4.8% in Denmark.

Table 93. Seriously injured drivers – Distribution of positive drivers – Drug-Drug combinations

Mutually exclusive group - Percentage of drivers positive for DRUG-DRUG combination						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	6.8	1.8	2.3	0.0	3.0
Denmark	2.7	4.3	6.4	1.1	0.0	3.7
Finland	0.0	10.0	14.3	0.0	N.A.	5.4
Italy	6.0	3.7	3.4	0.0	N.A.	3.3
Lithuania	0.0	1.9	1.5	0.0	8.3	1.3
The Netherlands	0.0	2.6	0.0	0.0	N.A.	0.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	3.8	0.0	0.0	0.0	1.1
Denmark	2.5	4.8	2.3	3.6	0.0	3.1
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	0.0	0.0	0.0	N.A.	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

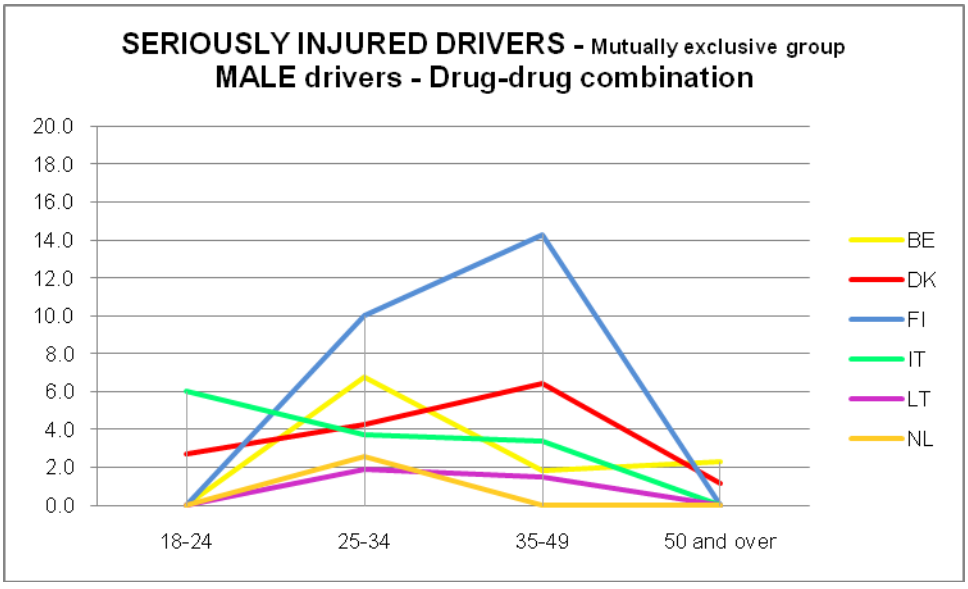


Figure 89. Mutually exclusive groups – Drug-drug combination: male drivers

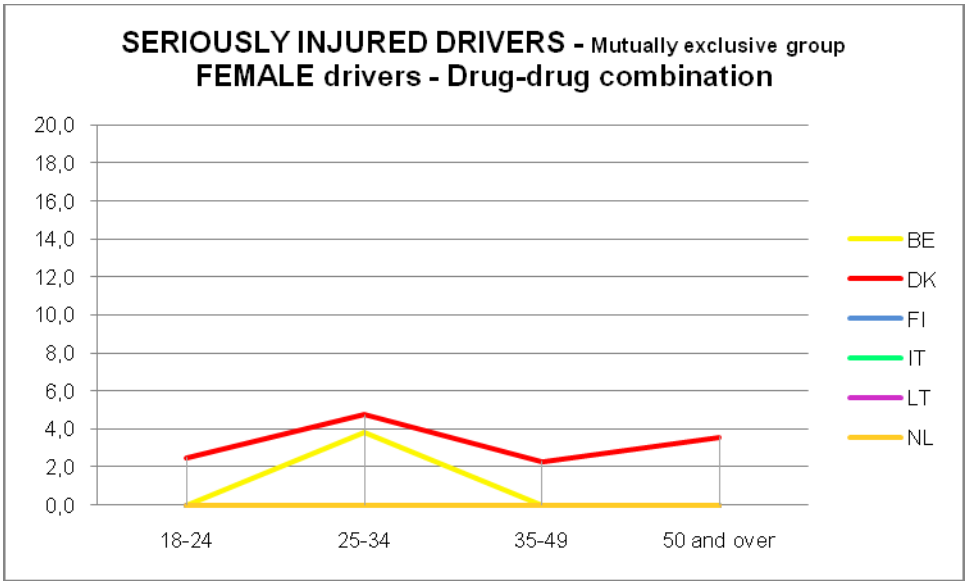


Figure 90. Mutually exclusive groups – Drug-drug combination: female drivers

3.7.6 Distribution of positive drivers during DRUID time periods aggregated into weekday, weeknight, weekend day and weekend night

Table 94. Seriously injured drivers – Distribution of positive drivers during day/night and week/weekends

Percentage of positive drivers on subjects involved in accidents during the same time period				
	Week day	Week night	Weekend day	Weekend night
Belgium	35.1	65.9	61.1	73.5
Denmark	24.6	59.5	32.9	52.9
Finland	15.8	80.0	57.9	75.0
Italy	20.1	60.6	32.2	48.3
Lithuania	26.4	18.2	24.7	50.0
The Netherlands	18.9	41.3	45.5	60.7

Apart from Lithuania, where the lowest percentage of positive subjects was found during week nights, in all other countries the lowest percentages of positive drivers was found in subjects involved in accidents occurred in a week day. In all countries the peak of positive drivers was found at nighttimes, either during the week or during the weekend. In general no statistical difference was found between week and weekend nights.

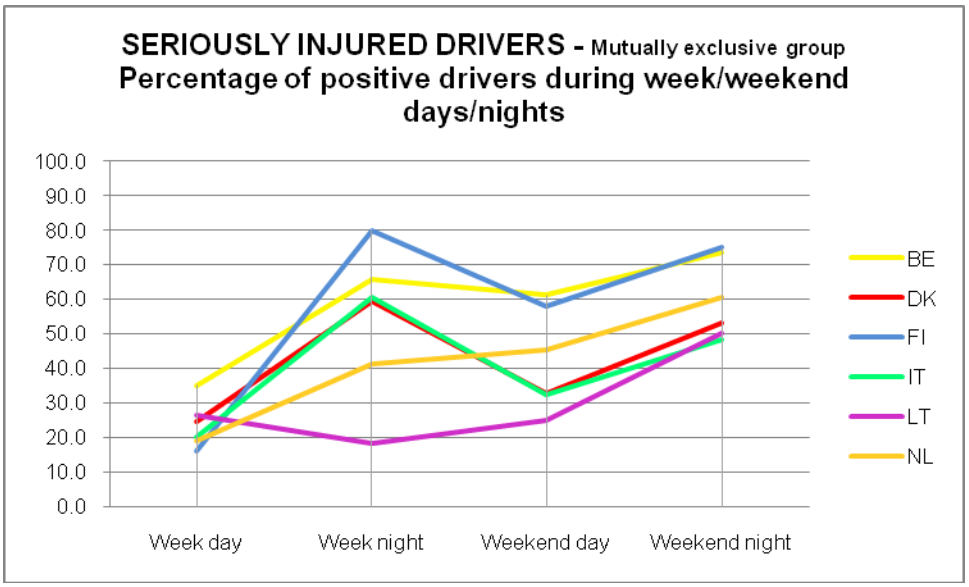
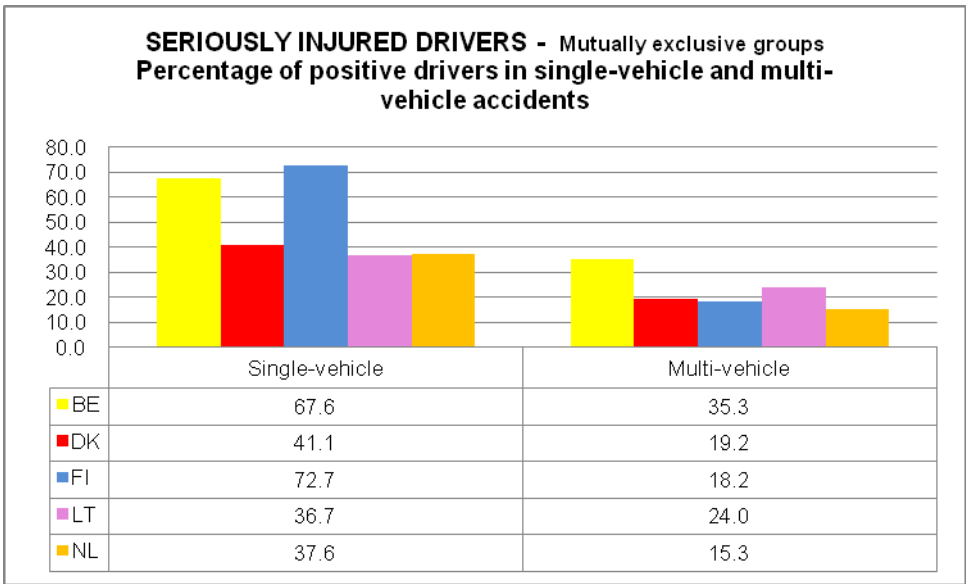


Figure 91. Mutually exclusive groups – Percentage of positive drivers during week/weekend day/night

3.7.7 Distribution of positive drivers in single-vehicle and multi-vehicle accidents



	Single-vehicle	Multi-vehicle
BE	67.6	35.3
DK	41.1	19.2
FI	72.7	18.2
LT	36.7	24.0
NL	37.6	15.3

Figure 92. Mutually exclusive groups – Percentage of positive drivers in single-vehicle and multi-vehicle accidents

Data about type of accident could not be recorded in Italy that therefore does not appear in the graph showing the percentage of positive drivers in single- and in multi-vehicle accidents. In all the other five countries, the percentage of drivers testing positive for one of the mutually exclusive groups is always higher in single-vehicle accidents than in multi-vehicle accidents, with a ratio of at least 1.5 to 1.

Table 95. Injured drivers – Distribution of type of accident by substance group

Substance groups		Type of accident		Total
		single- vehicle	multi-vehicle	
	negative	424(54.2%)	700(76.9%)	1124
	amphetamines only	7(0.9%)	6(0.7%)	13
	benzoylecgonine only	2(0.3%)	1(0.1%)	3
	THCCOOH only	5(0.6%)	10(1.1%)	15
	THC only	8(1.0%)	5(0.5%)	13
	benzodiazepines only	8(1.0%)	16(1.8%)	24
	z-drugs only	3(0.4%)	4(0.4%)	7
	medicinal opioids only	16(2.0%)	31(3.4%)	47
	alcohol only	217(27.7%)	85(9.3%)	302
	alcohol-drug	27(3.4%)	14(1.5%)	41
	drug-drug	66(8.4%)	38(4.2%)	104
Total		783(100%)	910(100%)	1693

More negatives were found in multi-vehicle accidents. Alcohol (alone or in combination), THC, benzoylecgonine and drug-drug combination were found more in single vehicle accidents. Benzodiazepines, medicinal opioids and THCCOOH were found more in multi-vehicle collisions.

3.8 Killed drivers – Distribution of positive drivers – Mutually exclusive groups

3.8.1 Distribution of positive drivers

Table 96. Killed drivers – Distribution of positive drivers

MUTUALLY EXCLUSIVE GROUPS - Percentage of negative and positive drivers				
Toxicological finding	**FI**	**NO**	**PT**	**SE**
Negative	57.7	60.0	52.3	69.5
Positive	42.3	40.0	47.7	30.5

In the killed driver study the highest percentage of positive drivers was found in Portugal, where a bigger proportion of sampled drivers tested positive for alcohol, both in the prevalence of use and in the mutually exclusive groups. Finland is the second country for drivers testing positive with a percentage relatively similar to the one recorded in the seriously injured drivers study (44.7%). The lowest percentage of positive drivers was found in Sweden.

3.8.2 Distribution of positive drivers by age and gender

As in the seriously injured drivers study, also in the killed drivers study the distribution by gender and age shows a higher percentage of positive drivers among the male group in all countries. This happens in all the first three age groups, up to 49 years, with the exception of Sweden, where the female group aged 18-24 shows a higher percentage of positive drivers compared to the one found in the same male age group. This is probably due to the small number of drivers included in the female group, in which 3 out of 4 subjects are positive for one of the mutually exclusive groups.
In the male group, in all countries, subjects aged 50 and over show the smallest percentage of positive drivers.
Once again, in the female groups percentage of positive subjects for one of the mutually exclusive groups tends to fluctuate more across different age groups and different countries, most likely as a consequence of the very small number of subjects included in each group.

Table 97. Killed drivers – Distribution of positive drivers by age and gender

Mutually exclusive group - Percentage of positive drivers						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	54.6	51.6	54.4	32.4	N.A.	45.6
Norway	41.5	61.5	57.7	18.9	N.A.	42.3
Portugal	46.3	66.2	63.8	31.3	14.3	50.2
Sweden	32.1	61.5	38.1	28.9	N.A.	35.5
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	18.8	30.0	45.2	16.1	N.A.	28.4
Norway	37.5	12.5	33.3	42.9	N.A.	31.4
Portugal	0.0	16.7	12.5	50.0	N.A.	15.0
Sweden	75.0	25.0	10.0	0.0	N.A.	14.7

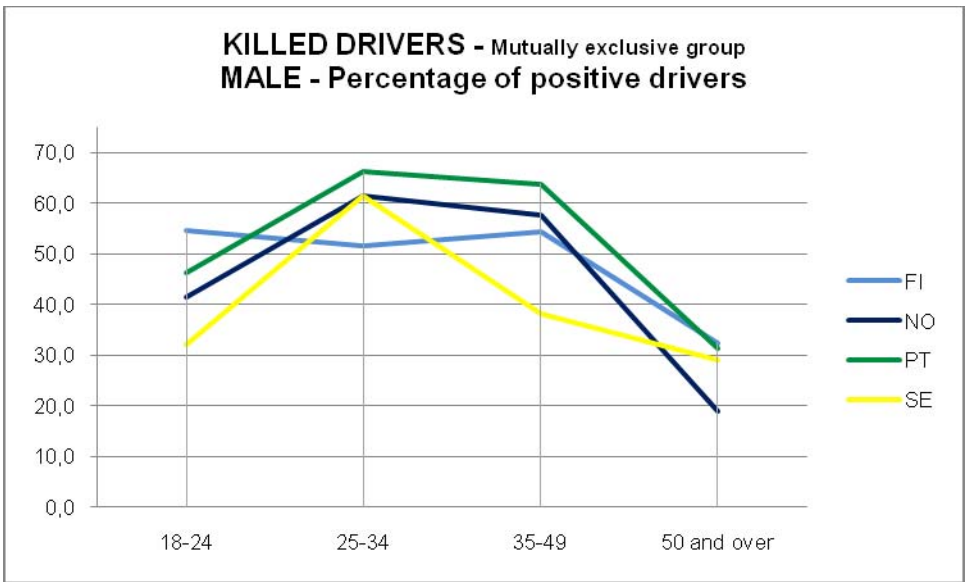


Figure 93. Mutually exclusive groups – Percentage of positive drivers: male

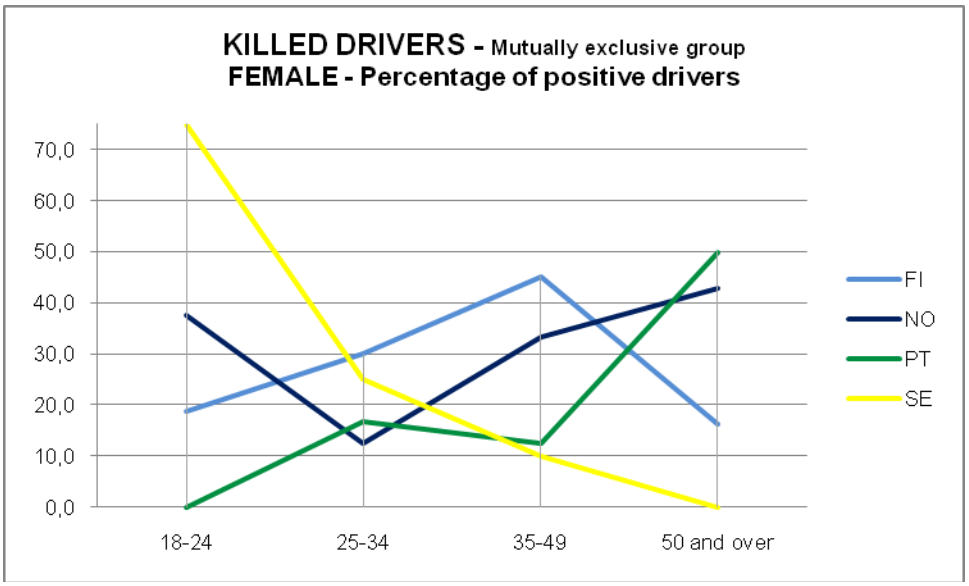


Figure 94. Mutually exclusive groups – Percentage of positive drivers: female

3.8.3 Distribution of positive drivers by substance groups

Table 98. Killed drivers – Distribution of positive drivers by substance groups

MUTUALLY EXCLUSIVE GROUPS - Distribution of drivers by substance groups				
Toxicological finding	**FI**	**NO**	**PT**	**SE**
Negative	57.7	60.0	52.3	69.5
Alcohol only	24.4	18.2	38.9	15.6
Amphetamine only	0.7	1.2	0.0	2.1
Benzoylecgonine only	0.0	0.0	0.0	0.0
Cocaine	0.0	0.0	0.0	0.0
THCCOOH only	N.A.	N.A.	1.1	0.0
THC	0.0	1.8	0.0	0.7
Illicit opiates only	0.0	0.0	0.0	0.0
Benzodiazepines only	5.2	1.8	0.7	0.0
Z-drugs only	1.7	1.2	0.0	2.8
Medicinal opioids only	1.5	0.6	0.7	0.7
Alcohol + drug combination	7.2	7.9	6.0	4.3
Drug + drug combination	1.5	7.3	0.4	4.3
Total	100.0	100.0	100.0	100.0

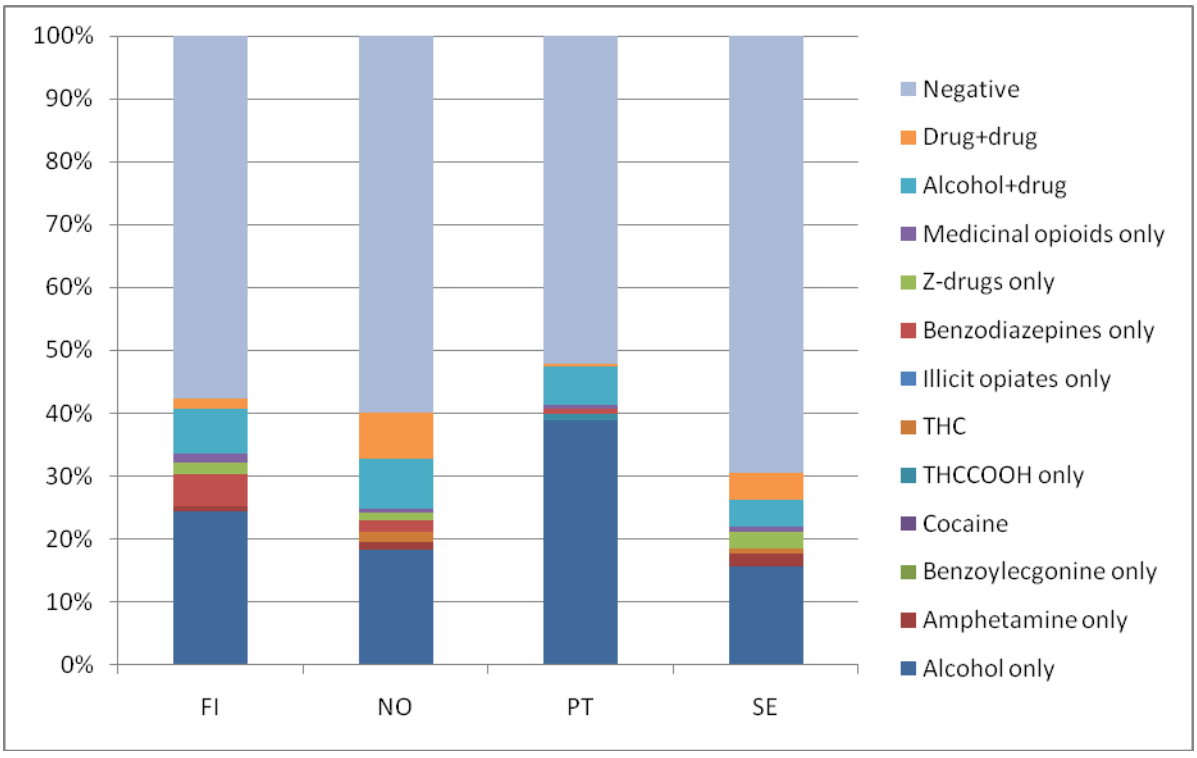


Figure 95. Killed drivers – Distribution of positive drivers by substance groups

Also in the killed driver study, in the distribution of positive drivers by substance groups, subjects who tested positive for “alcohol only” represent the largest group across all countries. For all countries the second most prevalent substance group is the one of “alcohol-drug combination”. In Sweden the same percentage was found for subjects

testing positive for the “alcohol-drug combination” and for the “drug-drug combination”. Different patterns were then found in the different countries for the other mutually exclusive groups, “benzodiazepines only”, “drug-drug combination”, “THCCOOH only” and “Amphetamines” being the third biggest groups in Finland, Norway, Portugal and Sweden respectively.

3.8.4 Distribution of positive drivers by amount of different substance groups taken

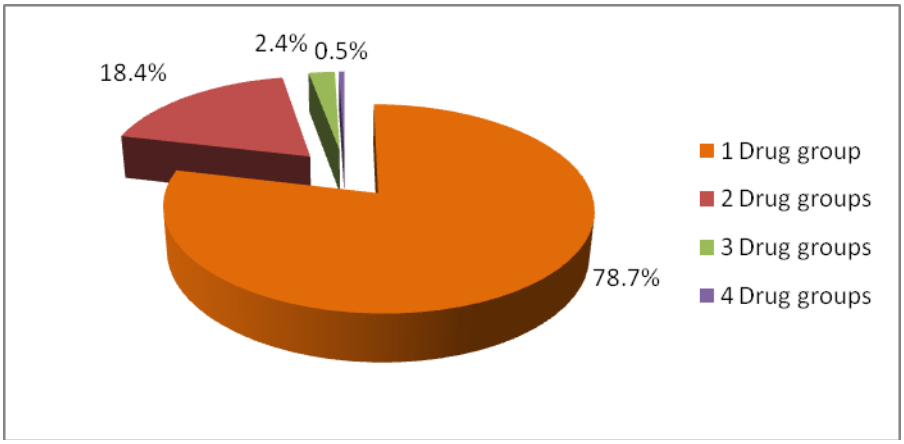


Figure 96. Killed drivers - General distribution by number of drug groups taken

In general of the drivers tested positive for one or more substances, 78.7% used a single drug and 18.4% tested positive for 2 substance groups. In this distribution ‘drug group’ is defined as the substance groups classified in table 14 (2.3 data analysis) with cases positive for alcohol also categorized as a drug-positive.

Table 99. Killed drivers – Distribution by country of number of different drug groups taken

Drug groups	Country			
	Finland	Norway	Portugal	Sweden
1	154 (79.4%)	42 (63.6%)	101 (87.8%)	32 (74.4%)
2	34 (17.5%)	21 (31.8%)	13 (11.3%)	9 (20.9%)
3	4 (2.1%)	3 (4.5%)	1 (0.9%)	2 (4.7%)
4	2 (1.0%)	0	0	0
Total	194 (100%)	66 (100%)	115 (100%)	43 (100%)

Only two Finnish person was found to have taken a combination of 4 substances. Combinations up to 3 different substance groups are seen in all countries involved in the killed driver study.
Because of the low number in some of the variables, a chi-square test could only be calculated for the first two categories. A significant difference was found between the countries for these substance group combinations (p=0.005). The single drug use was found in a lower percentage in Norway, resulting also in a higher percentage of substance group combinations in this country.

3.8.5 Distribution of substance groups by gender and age

Detailed distribution of substance groups by gender and age for each single country can be found in annex in the form of tables. Main findings have been summarised here below. Only for the “alcohol only”, “alcohol-drug” and “drug-drug” groups data are presented herein in the form of table and/or graphs, which show the pattern of positive subjects in the male and female drivers by age groups.

The highest prevalence of alcohol among all male and female subjects was found in Portugal (40.8% and 15.0% in the male and female group resp.), followed by Finland (26.3% and 14.8% in the male and female group resp). In Portugal 56.5% of the male subgroup aged 35-49 tested positive for alcohol only. In Finland 47.4% of the male drivers in the age group 18-24 was positive for alcohol only.
In Portugal 50% of the female subgroup aged 50 and over tested positive for alcohol only. However the female group in Portugal was very small amoung all age categories, and percentage should be considered very carefully. In Finland approximately 30% of the female subjects aged between 25 and 49 were find positive for alcohol only.

Table 100. Killed drivers – Distribution of positive drivers – Alcohol only

Mutually exclusive group - Percentage of drivers positive for ALCOHOL ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	47.4	29.7	26.5	11.3	N.A.	26.7
Norway	19.5	23.1	30.8	10.8	N.A.	20.0
Portugal	34.1	47.7	56.5	27.7	14.3	40.8
Sweden	21.4	23.1	19.0	13.3	N.A.	17.8
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	6.3	30.0	29.0	0.0	N.A.	14.8
Norway	0.0	12.5	25.0	0.0	N.A.	11.4
Portugal	0.0	16.7	12.5	50.0	N.A.	15.0
Sweden	75.0	0.0	0.0	0.0	N.A.	8.8

While no positive findings were recorded in Portugal, the highest prevalence of **amphetamines only** in the male group was find in Sweden (2.8%), followed by Norway (1.5%) and Finland (0.8%). None of the drivers in the female group tested positive for amphetamine only. (Table 123, annex 3)

No positive cases of **benzoylecgonine only** and **cocaine only** were recorded in the subpopulations of the four countries participating in the killed driver study. (Table 124-125, annex 3)

Finland and Norway did not screen the samples for THCCOOH, therefore no data are available for this substance in these two countries. Positive findings for **THCCOOH only** were recorded only in Portugal and only in the male group (1.1%). (Table 126, annex 3)

Norway and Sweden were the only two countries with drivers testing positive for **THC only** (with or without THCCOOH). All were in the male group, with the highest prevalence found in Norway (2.3%). Positives were only in to the first two age groups. (Table 127, annex 3)

For the **benzodiazepines only** group, no positive findings were recorded in Sweden in both gender groups and in Portugal in the female group. The highest percentage of

positive subjects were detected in Finland both in the male (4.6%) and in the female (8.0%) subpopulations. (Table 129, annex 3)

No cases of **Z-drugs only** were found in Portugal. In the other countries the highest percentage was found in Sweden in the male group (2.8%) followed by Finland (2.2%). Female subjects positive for Z-drugs only were recorded in Norway and Sweden (both 2.9%). (Table 130, annex 3)

In the male subgroup the highest prevalence of **medicinal opioids only** was found in Finland (1.9%), followed by Sweden (1.9%) and Portugal (0.8%), while no positive findings were recorded in Norway. In contrast among all female subjects, positive cases were recorded only in Norway (2.9%). (Table 131, annex 3)

Subjects positive for **alcohol-drug** combinations were found in all countries in the male subgroups. The highest prevalence was found in Norway (9.2%), followed by Finland (7.8%). While in Portugal no female subjects tested positive for a alcohol-drug combination in the other countries prevalence ranged from 2.9% (Norway and Sweden) to 4.5% (Finland).

Table 101. Killed drivers – Distribution of positive drivers – Alcohol-Drug combinations

Mutually exclusive group - Percentage of drivers positive for ALCOHOL-DRUG combination						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	3.1	15.6	16.2	3.5	N.A.	7.8
Norway	17.1	15.4	0.0	2.7	N.A.	9.2
Portugal	9.8	10.8	7.2	1.2	0.0	6.4
Sweden	3.6	15.4	4.8	2.2	N.A.	4.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	6.3	0.0	6.5	3.2	N.A.	4.5
Norway	12.5	0.0	0.0	0.0	N.A.	2.9
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	25.0	0.0	0.0	N.A.	2.9

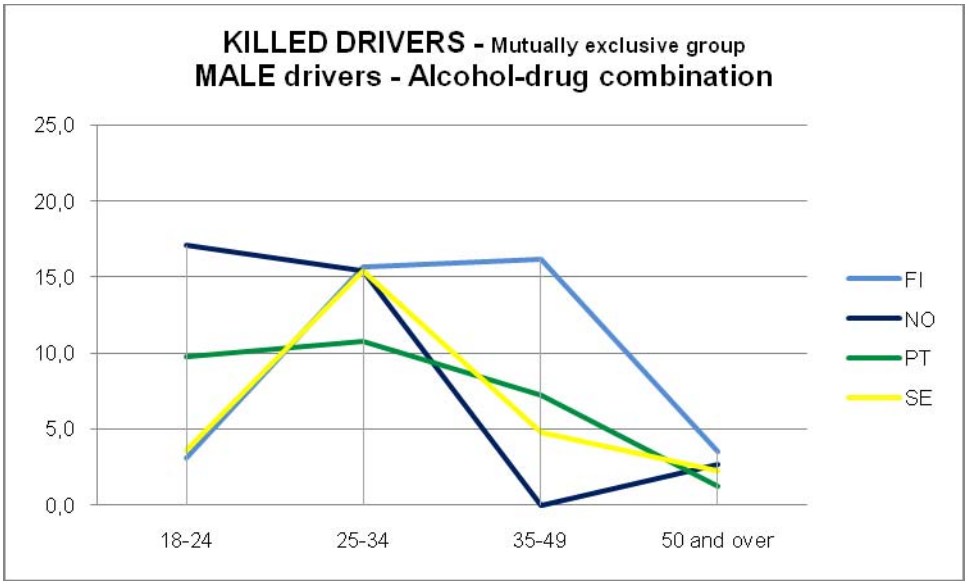


Figure 97. Mutually exclusive groups – Alcohol-drug combination: male drivers

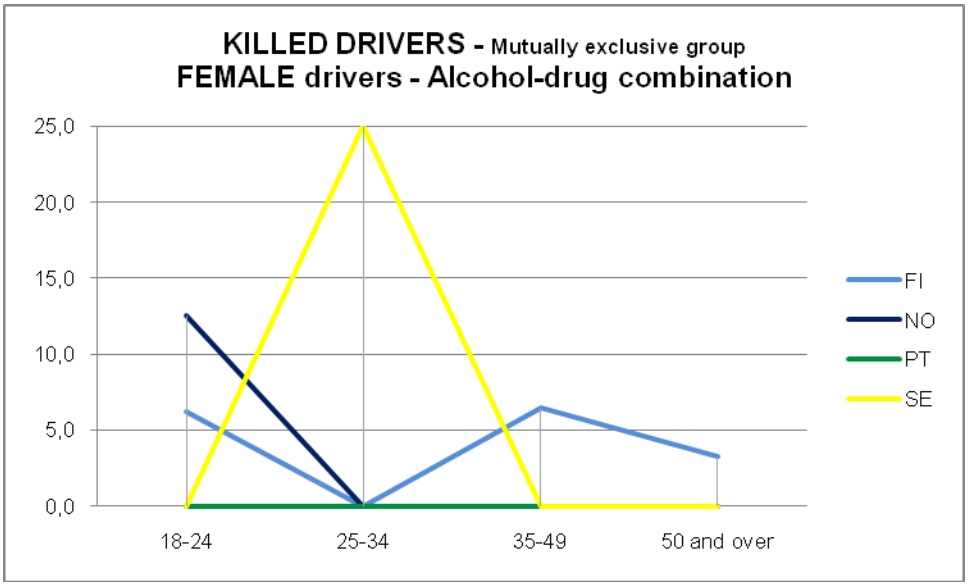


Figure 98. Mutually exclusive groups – Drug-drug combination: female drivers

Drug-drug combinations were recorded in all countries in the male group and only in Finland and Norway in the female group. These subjects accounted for a percentage of positives ranging between 0.4 (Portugal) and 7.7 (Norway) in the male group, and between 1.1 (Finland) and 5.7 (Norway) among the female subpopulations.

Table 102. Killed drivers – Distribution of positive drivers – Drug-Drug combinations

Mutually exclusive group - Percentage of drivers positive for DRUG-DRUG combination						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	1.6	4.4	1.4	N.A.	1.6
Norway	0.0	15.4	19.2	2.7	N.A.	7.7
Portugal	0.0	1.5	0.0	0.0	0.0	0.4
Sweden	0.0	15.4	4.8	6.7	N.A.	5.6
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	3.2	N.A.	1.1
Norway	0.0	0.0	8.3	14.3	N.A.	5.7
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

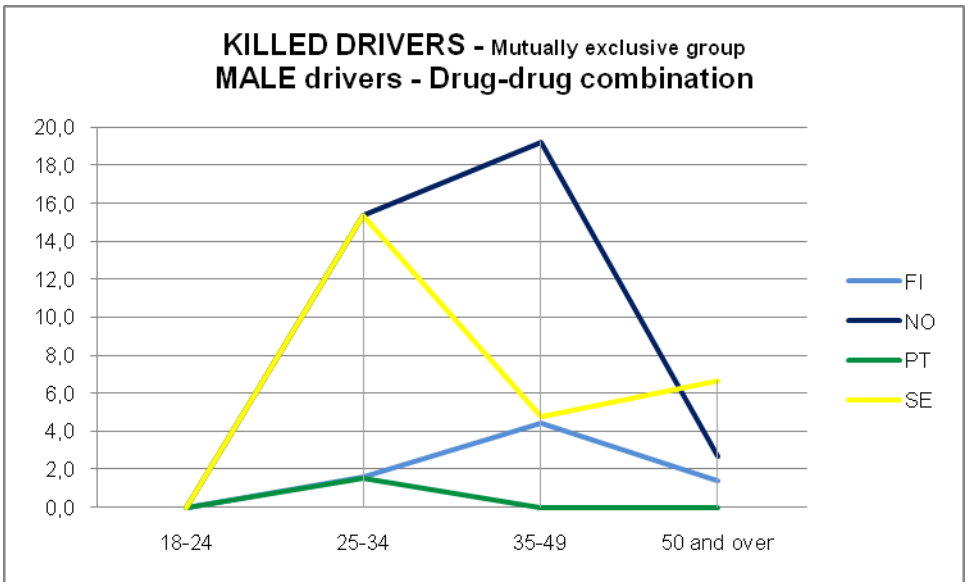


Figure 99. Mutually exclusive groups – Drug-drug combination: male drivers

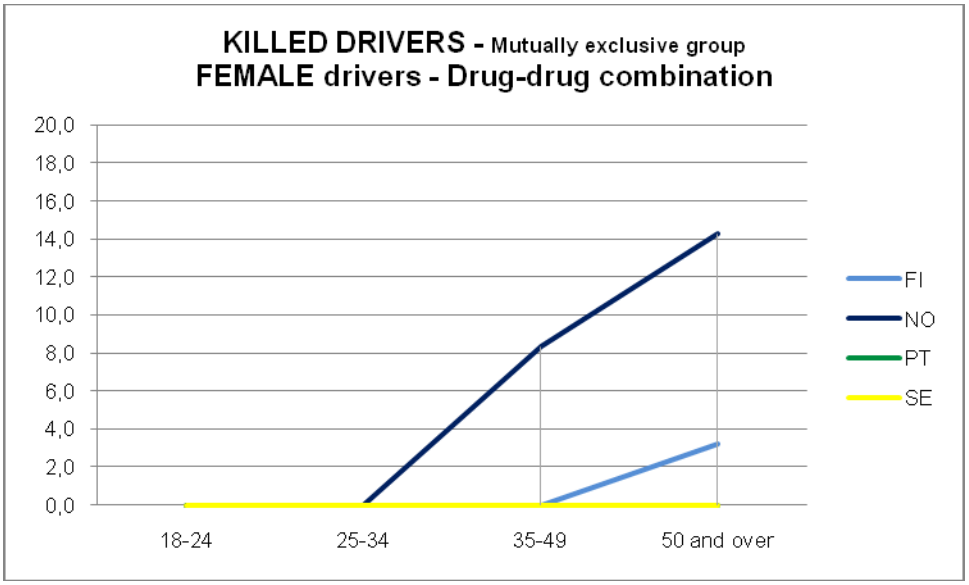


Figure 100. Mutually exclusive groups – Drug-drug combination: female drivers

3.8.6 Distribution of positive drivers during DRUID time periods aggregated into weekday, weeknight, weekend day and weekend night

Table 103. Killed drivers – Distribution of positive drivers during day/night week/weekends

Percentage of positive drivers on subjects involved in accidents during the same time period				
	Week day	Week night	Weekend day	Weekend night
Finland	30.4	67.5	43.7	78.0
Norway	28.4	66.7	39.5	88.9
Portugal	31.6	70.8	52.2	80.0
Sweden	23.3	85.7	24.2	60.0

Also in the killed drivers study the lowest percentage of positive drivers were found in accidents that occurred during weekdays. The highest percentages of positive drivers were found in night time accidents. No significant difference was found regarding the distribution of positive findings in week vs weekend nights (p=0.562).The percentage of drivers, involved in a day accident, testing positive for one of the mutually exclusive groups appeared to be generally lower in Sweden than in the other countries.

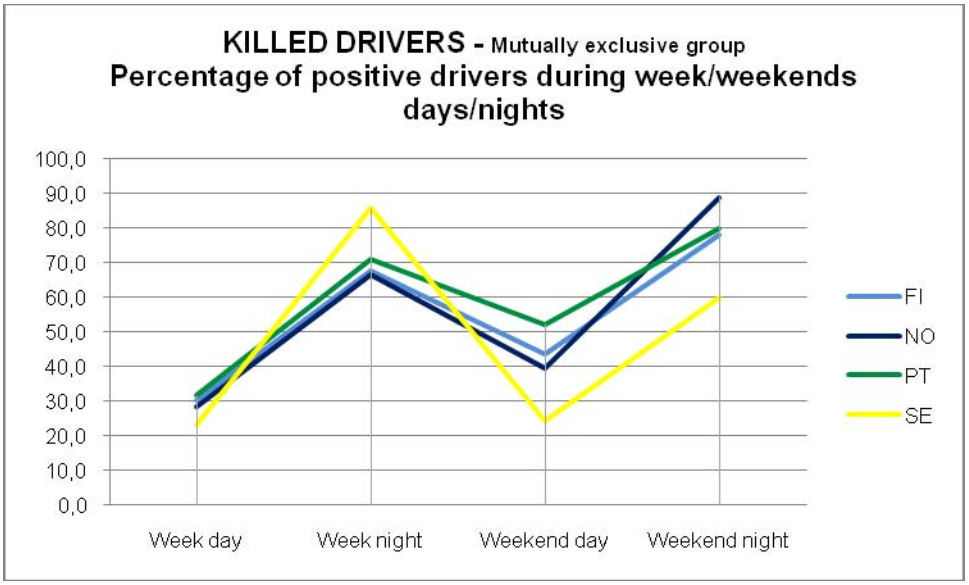
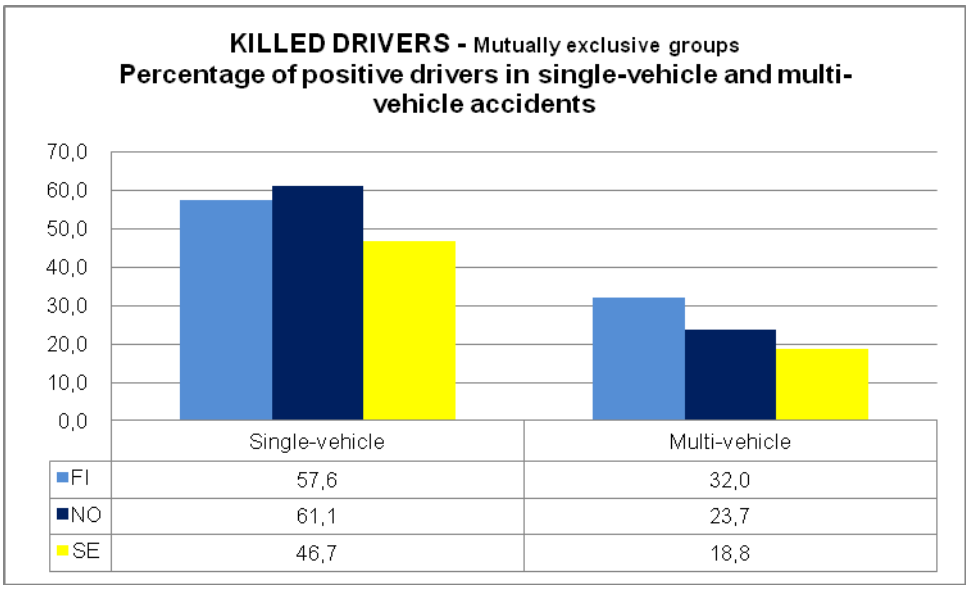


Figure 101. Mutually exclusive groups – Percentage of positive drivers during week/weekend day/night

3.8.7 Distribution of positive drivers in single-vehicle and multi-vehicle accidents



	Single-vehicle	Multi-vehicle
FI	57,6	32,0
NO	61,1	23,7
SE	46,7	18,8

Figure 102. Mutually exclusive groups – Percentage of positive drivers in single-vehicle and multiple-vehicle accident

Data about type of accident could not be recorded in Portugal that therefore does not appear in the graph. In all the other three countries, the percentage of drivers testing positive for one of the mutually exclusive groups was always higher in single-vehicle accidents than in multi-vehicle accidents, with a ratio of at least 1.8 to 1.

Table 104. Killed drivers - Distribution of type accident by substance group

Substance groups		Type of accident		Total
		single vehicle	multi vehicle	
	negative	138(39.9%)	323(66.5%)	461
	amphetamines only	4(1.2%)	4(0.8%)	8
	THC only	1(0.3%)	3(0.6%)	4
	benzodiazepines only	7(2.0%)	20(4.1%)	27
	z-drugs only	5(1.4%)	9(1.9%)	14
	medicinal opioids only	4(1.2%)	5(1.0%)	9
	alcohol only	109(31.5%)	55(11.3%)	164
	drug-drug	10(2.9%)	15(3.1%)	25
	alcohol-drug	38(11.0%)	14(2.9%)	52
Total		346(100%)	486(100%)	833

More negatives were found in multi-vehicle accidents. Alcohol (alone or in combination) was found more in single vehicle accidents. THC, benzodiazepines and z-drugs were more found in multi-vehicle collisions. Amphetamines, medicinal opioids, and drug-drug combinations are equally distributed.

3.9 Distribution of concentrations

3.9.1 Distribution of core substances and Tramadol

Distribution of concentrations are reported for core substances and tramadol, that has been included in the "medicinal opioids" substance group (2.3 Data analysis: Table 14). Data are based on all recorded values in the six countries participating in the seriously injured drivers study and in the four countries participating in the killed drivers study.
Data from the seriously injured drivers study and the killed drivers study are shown separately in two different tables.

In both tables, the number of samples screened for each listed substance is reported in the third column. Minimum, maximum, median and mean concentrations are reported for each detected substance. In each table two sets of data are presented.
Under "Concentrations at or above the DRUID cut-off", the number of samples that tested positive at or above the DRUID cut-off is reported. Based on this first group of samples, minimum, maximum, median and mean concentrations are presented.
Under "All recorded concentrations", the total number of samples for which a concentration was recorded is reported, including the ones with value below the DRUID cut-offs. Based on this second group of findings minimum, median and mean concentrations are reported.

Table 105. Seriously injured drivers – Distribution of concentrations for core substances and tramadol

SERIOUSLY INJURED DRIVERS											
Substance	DRUID cut-off (ng/mL)	Number of samples screened	Concentrations at or above DRUID cut-off					All recorded concentrations			
			Pos	Min.	Max.	Median	Mean	Pos	Min.	Median	Mean
Ethanol	0.1 g/L	2486	609	0.10	4.20	1.60	1.59	615	0.06	1.59	1.57
6-acetylmorphine	10	2484	1	12.4	12.4	12.4	12.4	8	0.6	3.2	4.2
Alprazolam	10	2484	6	18.5	128	44.5	52.3	20	1.0	8.2	19.2
Amphetamine	20	2485	45	20.0	1095	102	215	61	1.0	49.3	160
Benzoylecgonine	50	2480	71	51.6	1500	254	338	108	0.5	138	228
Clonazepam	10	2484	30	11.2	174	40.2	45.8	33	2.3	37.8	41.9
Cocaine	10	2484	36	10.0	400	35.5	59.5	67	0.5	11.6	34.2
Codeine	10	2484	18	10.0	66.9	20.5	27.1	37	0.5	8.7	15.2
Diazepam	20	2480	41	20.0	1747	112	234	62	0.7	45.7	158
Flunitrazepam	2	2480	4	5.9	12.1	8.0	8.5	7	1.1	5.9	5.5
Lorazepam	10	2483	13	12.0	114	25.6	37.7	21	0.5	17.4	24.0
MDA	20	2485	1	43.4	43.4	43.4	43.4	5	6.0	13.6	18.1
MDEA	20	2485	0	N.A.	N.A.	N.A.	N.A.	0	N.A	N.A.	N.A.
MDMA	20	2485	5	29.3	436	93.9	199	7	3.8	47.6	144
Methadone	10	2483	29	13.0	581	72.0	140	31	1.6	65.0	131
Methamphetamine	20	2485	11	22.2	240	125	112	17	2.0	27.6	74.6
Morphine	10	2470	58	11.0	898	31.5	65.3	77	0.5	24.0	50.0
Nordiazepam	20	2481	46	27.9	854	138	223	73	1.1	54.3	143
Oxazepam	50	2483	14	55.2	1486	174	303	47	1.0	12.7	96.7
THC	1	2481	68	1.0	19.7	2.3	3.0	94	0.2	1.5	2.3
THCCOOH	5	2482	121	5.0	351	23.7	40.0	145	1.0	15.0	33.8
Tramadol	50	2480	33	55.7	5098	300	596	51	1.0	121	392
Zolpidem	20	2484	11	31.6	1161	131	238	14	6.9	75.0	190
Zopiclone	10	2484	8	12.0	422	59.6	103	14	0.5	15.8	61.4

Table 106. Killed drivers – Distribution of concentrations for core substances and tramadol

KILLED DRIVERS											
Substance	DRUID cut-off (ng/mL)	Number of samples screened	Concentrations at or above DRUID cut-off					All recorded concentrations			
			Pos	Min.	Max.	Median	Mean	Pos	Min.	Median	Mean
Ethanol	0.1 g/L	1102	354	0.10	3.70	1.67	1.61	383	0.01	1.60	1.49
6-acetylmorphine	10	1072	0	N.A.	N.A.	N.A.	N.A.	0	N.A.	N.A.	N.A.
Alprazolam	10	1087	15	12.7	100	30.0	44.8	17	8.2	30.0	40.6
Amphetamine	20	1083	28	20.3	120000	420	5151	30	6.8	406	4808
Benzoylecgonine	50	1074	7	73.0	1613	277	483	7	73.0	277	483
Clonazepam	10	1087	4	10.7	60.9	16.4	26.1	6	2.5	11.0	18.3
Cocaine	10	1082	3	35.0	68.0	50.5	51.2	4	9.1	42.8	40.7
Codeine	10	1082	6	20.0	731	40.0	156	7	9.3	40.0	135
Diazepam	20	1081	47	20.0	1200	200	257	50	4.4	151	242
Flunitrazepam	2	1087	0	N.A.	N.A.	N.A.	N.A.	4	0.3	0.9	0.9
Lorazepam	10	1062	4	10.0	20.0	20.0	17.5	5	4.4	20.0	14.9
MDA	20	1077	1	273	273	273	273	2	16.1	145	145
MDEA	20	1046	0	N.A.	N.A.	N.A.	N.A.	0	N.A.	N.A.	N.A.
MDMA	20	1083	4	300	1511	317	611	4	300	317	611
Methadone	10	1087	1	12310	1231	1231	1231	1	1231	1231	1231
Methamphetamine	20	1083	11	40.0	2939	411	803	12	11.9	372	737
Morphine	10	1075	12	11.8	345	53.5	82.3	16	0.7	34.0	62.1
Nordiazepam	20	1087	54	20.0	1600	100	238	57	10.8	100	226
Oxazepam	50	1087	25	50.0	2400	300	482	38	1.5	100	325
THC	1	1082	19	1.1	20.5	3.4	5.2	29	0.3	2.2	3.6
THCCOOH	5	430	11*	6.0	95.0	12.0	25.7	11*	6.0	12.0	25.7
Tramadol	50	905	9	146	2966	605	758	9	146	605	758
Zolpidem	20	1087	6	90.0	708	250	311	6	90.0	250	311
Zopiclone	10	802	22	10.9	800	60.0	134	23	3.5	60.0	128

* 11 samples tested positive for THCCOOH, however for one of them exact concentration was not reported, as the value was above the calibration curve. Maximum, median and mean concentrations are therefore based on 10 values

Concentrations recorded in this study are not from controlled administration of drugs, and, therefore, they represent the result of different consumption patterns. For example, MDA and oxazepam are drugs themselves, but they are also breakdown products in the body of MDMA and diazepam/nordiazepam respectively. Codeine can be found as a consequence of therapeutic use, but also as breakdown product of acetylcodeine, an impurity present in street heroin. Also, depending on time between accident and blood sampling, the concentration of certain drugs may have decreased significantly due to their short halflife in the body and normal metabolism. For these reasons, for some of the listed drugs, minimum, maximum, median and mean concentrations obtained from the data gathered could be the results of concentrations derived both from therapeutic/illicit use and from metabolism.

For the seriously injured drivers study, when all recorded concentrations are considered, median and mean are found to be above the DRUID cut-off for almost all substances. For alprazolam, codeine, MDA and oxazepam the median concentration is found to be lower than the set cut-offs. Among all detected core substances for which a concentration was measured, 6-acetymorphine is the only one for which both median and mean concentrations are found to be below the DRUID cut-off. 6-acetylmorphine is the first break down product of heroin in the body that lasts very shortly, being rapidly converted into morphine. This, with the fact that 6-acetylmorphine may break down after blood sampling, is likely to explain the low concentrations detected.

The same cut-offs have been applied in the seriously injured drivers study and in the killed drivers study, however data for the killed drivers study are presented separately as concentrations of drugs may change after death. This can be due to bacterial and fungal activity that, for example, can either produce or consume alcohol as well as degrade other substances, or to drugs being released after death into the blood from tissues, such as the liver, where they were accumulated during life, due to a phenomenon known as "post-mortem redistribution". The site of sampling may also determine significant differences in observed concentrations, with a blood sample taken from the heart normally containing higher drug concentrations than a blood sample taken from a peripheral site, such as the femoral vein.
In general, in the killed drivers study, median and mean concentrations obtained considering all recorded values are above the DRUID cut-off for all substances apart from flunitrazepam. This benzodiazepine is known to degrade rapidly in post-mortem samples, a fact that is likely to explain the very low concentrations detected.

Although in all countries hospital staff was asked to record any drug administered before blood sampling on the patient form, there is the possibility that in some cases this procedure was not followed. This possibility is raised when looking at concentrations measured that, for some drugs and in some cases, appear to be relatively high to result from normal therapeutic use. This is for example the case of morphine and tramadol. For morphine, according to the scientific literature, concentrations in the range of 20 ng/mL are considered sufficient for pain management in cancer patients, and concentrations in the range of 300 ng/mL, in non-tolerant subjects, are associated with loss of consciousness requiring assisted ventilation. For tramadol, in a previous study on drug-impaired driving, the average concentration was found to be around 500 ng/mL[14].
While high concentrations recorded in the killed drivers study may be explained by post-mortem redistribution or a sample havin been taken not from a peripheral site, some of the high concentrations recorded in the seriously injured drivers study appear more likely to be in the range of those found during emergency treatment than in normal pain management. This observation leads to the possibility that, in a few cases, the administration of drugs prior to blood sampling may have not been recorded on the patient form.

[14] Baselt RC. Disposition of toxic drugs and chemicals in man. Biomedical publications Foster city, California, 2004

3.9.2 Concentrations of drugs found alone and in combination

Table 107. Distribution of concentrations for core substances and tramadol

Substance	DRUID cut-off (ng/mL)	Injured Drivers					Killed Drivers				
		Concentrations at or above DRUID cut-off					Concentrations at or above DRUID cut-off				
		Pos	Min.	Max.	Median	Mean	Pos	Min.	Max	Median	Mean
Ethanol only	0.1 g/L	458	0.10	4.20	1.60	1.60	285	0.10	3.70	1.68	1.62
Ethanol combination	0.1 g/L	151	0.10	3.31	1.60	1.56	69	0.12	3.15	1.60	1.57
6-acetylmorphine combination	10	1	12.4	12.4	12.4	12.4	0	N.A.	N.A.	N.A.	N.A.
Alprazolam only	10	2	18.5	19.5	19.0	19.0	4	18.5	100	31.0	45.1
Alprazolam combination	10	4	35.0	128	56.3	69.0	11	12.7	100	30.0	44.7
Amphetamine only	20	7	23.9	328	208	167	6	35.3	120000	445	20338
Amphetamine combination	20	38	20.0	1095	101	223	23	20.3	4931	430	1012
Benzoylecgonine only	50	8	52.0	570	189	218	0	N.A.	N.A.	N.A.	N.A.
Benzoylecgonine combination	50	63	51.6	1500	257	353	7	73.0	1613	277	483.7
Clonazepam only	10	4	26.0	74.9	56.5	53.5	0	N.A.	N.A.	N.A.	N.A.
Clonazepam combination	10	26	11.2	474	38.5	44.6	4	10.7	60.9	16.4	26.1
Cocaine only or in combination with benzoylecgonine	10	5	20.0	400	170	170	0	N.A.	N.A.	N.A.	N.A.
Cocaine combination, other	10	31	10.0	208	33.0	41.6	3	35.0	68.0	50.5	51.2
Codeine only	10	6	10.6	54.3	33.1	33.6	4	20.0	70.0	40.0	42.5
Codeine combination	10	12	10.0	66.9	16.5	23.9	2	36.1	731	383	383
Diazepam only	20	7	20.0	277	30.0	71.9	3	30.0	50.0	30.0	36.7
Diazepam combination	20	34	23.2	1747	132	268	44	20.0	1200	200	272
Flunitrazepam only	2	1	5.9	5.9	5.9	5.9	0	N.A.	N.A.	N.A.	N.A.
Flunitrazepam combination	2	3	6.1	12.1	9.9	9.4	0	N.A.	N.A.	N.A.	N.A.
Lorazepam only	10	5	12.0	41.2	23.0	26.3	2	20.0	20.0	20.0	20.0
Lorazepam combination	10	8	17.3	114	32.3	44.8	4	10.0	20.0	20.0	17.5
MDA combination	20	1	43.4	43.4	43.4	43.4	1	273	273	273	273
MDMA only	20	1	29.3	29.3	29.3	29.3	1	314	314	314	314
MDMA combination	20	4	47.6	436	241	241	3	300	1511	320	710
Methadone only	10	8	13.0	177	49.5	70.3	0	N.A.	N.A.	N.A.	N.A.
Methadone combination	10	21	26.0	581	91.0	167	1	1231	1231	1231	1231
Methamphetamine only or in combination with amphetamine	20	4	22.2	240	133	132	2	40.0	2939	1489	1489
Methamphetamine combination, other	20	7	26.2	177	125	100	9	148	1658	411	650
Morphine only	10	26	11.0	103	27.0	37.0	4	34.0	128	60.5	70
Morphine combination	10	32	12.3	898	42.5	88.2	8	11.8	345	45.0	88

Nordiazepam only	20	2	42.0	76	59.0	59.0	4	40.0	90.0	51.5	58
Nordiazepam combination	20	44	27.9	854	142	231	50	20.0	1600	100	253
Oxazepam only	50	1	164	164	164	164	8	50.0	2400	359	624
Oxazepam combination	50	13	55.2	148	176	314	17	70.0	1600	289	414
THC only or in combination with THCCOOH	1	24	1.0	19.7	2.2	3.7	4	2.2	20.5	6.9	9.1
THC combination	1	44	1.0	8.0	2.3	2.6	15	1.1	10.9	3.1	4.2
THCCOOH only	5	19	5.0	112.5	24.5	35.3	3*	16.0	82.0	49.0	49.0
THCCOOH combination	5	100	5.0	351	21.7	40.8	9	6.0	95.0	10.0	20.6
Tramadol only	50	24	55.7	5098	243	651	3	146	607	200	317
Tramadol combination	50	9	63.8	1012	414	450	6	300	2966	652	978
Zolpidem only	20	6	31.6	436	94.3	157	3	90.0	708	300	366
Zolpidem combination	20	5	79.1	1161	131	336	3	100	471	200	257
Zopiclone only	10	3	19.6	82.2	22.5	41.4	12	10.9	419	53.0	92.8
Zopiclone combination	10	5	12.0	422	111	141	10	19.1	800	100	183

*11 samples tested positive for THCCOOH, however for one of them the exact concentration was not reported, as the value was above the calibration curve. Maximum, median and mean concentrations are therefore based on 10 values.

The concentration ranges of ethanol found alone or in combination with other drugs were similar. This happened in both the seriously injured and killed drivers study.
In the injured drivers study, for the majority of substances, the concentration range was wider when the drug was found in combination compared to when the drug was found alone. Exceptions were found for metamphetamine, THC and tramadol, for which the concentration range was smaller when the drug was combined with other psychoactive substances.
Also in the killed driver study, for the majority of substances (when leaving out the outliers), the concentration range was wider when drugs were found in combination with other psychoactive substances. This trend was not shown by certain substances, and in particular in the case of alprazolam (equal when alone and in association), metamphetamine, oxazepam, THC and zolpidem (wider concentration range when found alone compared to when found in combination)

3.9.3 Distribution of the alcohol concentrations

In general 24.4% of the injured drivers population was positive for alcohol. Of these 609 subjects, 9.5% had a BAC between 0.1g/L (= DRUID cut-off) and 0.5 g/L (= legal cut-off in most countries involved) and 65.7% had a BAC ≥ 1.3 g/L.
Among all subjects testing positive for alcohol the highest percentage of drivers with a BAC between 0.1 and 0.5 g/L was found in Italy (10.9%) followed by Belgium (10.1%) and Denmark (9.7%). Among the same sample the highest percentage of subjects with a BAC ≥ 1.3 g/L was found in Finland (76.5%), followed by Lithuania (70.6%) and Belgium (68.2%).

Table 108. Injured drivers- Distribution of positive alcohol findings by BAC-group

BAC group	Frequency	Percent
0.1 ≤ BAC < 0.5 g/L	58	9.5
0.5 ≤ BAC < 0.8 g/L	48	7.9
0.8 ≤ BAC <1.3 g/L	103	16.9
BAC ≥ 1.3 g/L	400	65.7
Total	**609**	**100.0**

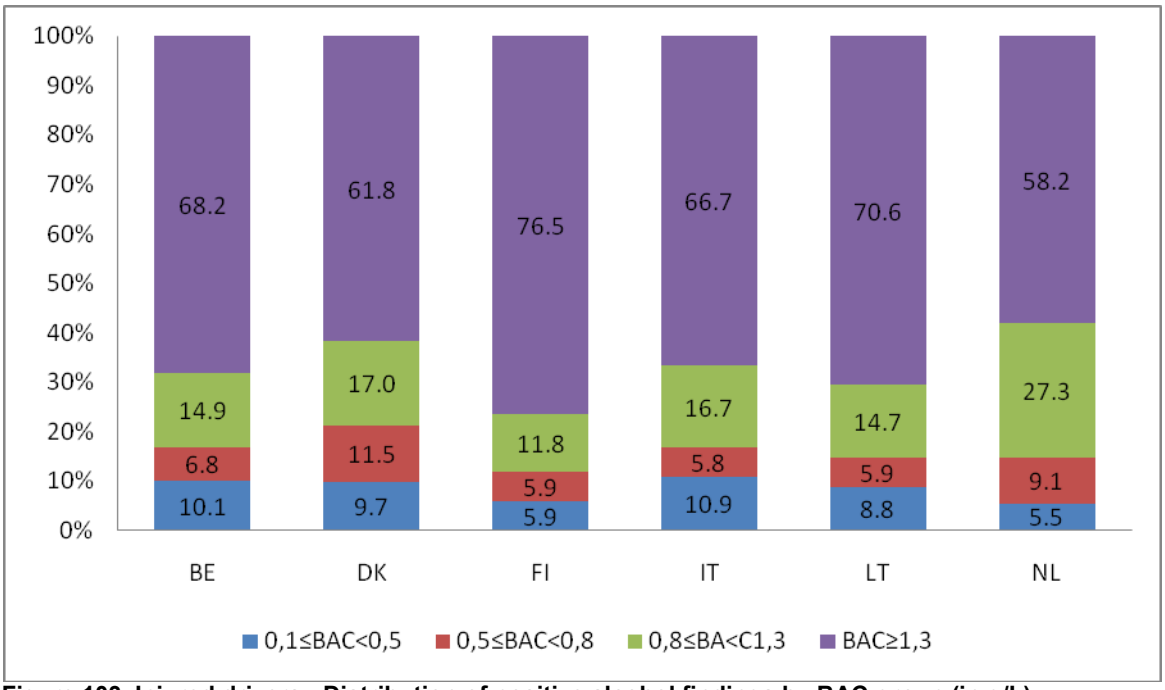


Figure 103. Injured drivers - Distribution of positive alcohol findings by BAC-group (in g/L) and by country

In general 31.7% of the killed driver population was positive for alcohol. Of these 354 subjects, 12.7% had a BAC between 0.1g/L (= DRUID cut-off) and 0.5 g/L (= legal cut-off in most countries involved). 70.6% of the killed drivers testing positive for alcohol had a BAC > 1.3 g/L.
In the killed driver study, among all subjects testing positive for alcohol the highest percentage of drivers with a BAC between 0.1 and 0.5 g/L was found in Portugal (21.9%) followed by Sweden (13.8%). Among the same sample the highest percentage of subjects with a BAC ≥ 1.3 g/L was found in Finland (83.8%), followed by Norway (71.4%).

Table 109. Killed drivers- Distribution of positive alcohol findings by BAC-group

BAC group	Frequency	Percent
0.1 ≤ BAC < 0.5 g/L	45	12.7
0.5 ≤ BAC < 0.8 g/L	26	7.3
0.8 ≤ BAC <1.3 g/L	33	9.3
BAC ≥ 1.3 g/L	250	70.6
Total	354	100.0

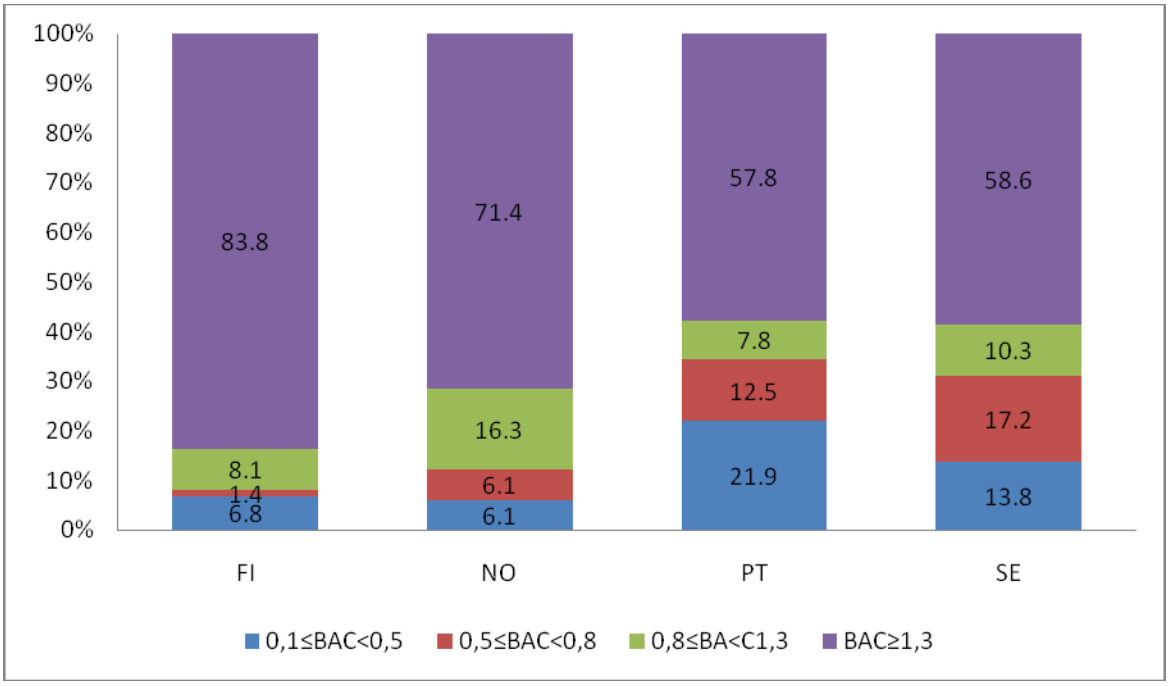


Figure 104. Killed drivers- Distribution of positive alcohol findings by BAC-group (in g/L) and by country

3.9.4 Comparison of the concentrations in injured and killed driver population

Comparison between concentrations found in injured and killed drives should be made very carefully. This is because, as already mentioned, in post-mortem samples concentrations of drugs not only depend on site of blood sampling (with higher concentrations often found in heart blood compared to periferal blood), but can also increase or decrease after death, due to post-mortem changes. Also, in the case of those drivers who did not die immediately at the scene of the accident and the blood sample was collected only during the post-mortem examination, drugs may have been partially or completely eliminated during the survival time, which extended up to 24 hours for some subjects.

In general, when considering the different number of subjects included in the two studies (with a ratio of aproximately 2:1 between injured and killed drivers), the number of subjects testing positive was relatively similar in the two studies only for alcohol, amphetamine and zolpidem. For the other substances, for which at least 5 positive findings at or above the DRUID cut-off were recorded, the number of positive was in general higher in the seriously injured drivers population than in the killed drivers population. This happened for all substances apart from alprazolam, diazepam, nordiazepam, oxazepam, methamphetamine and zopiclone, for which the number of positive findings was higher in the killed drivers study.

When looking at median and mean concentrations, differences could be noticed between the concentrations recorded in the two studies. These are likely to be the consequence both of the different number of cases recorded in the two studies and of the phenomena that may lead to drugs concentration changes (for example: post-mortem redistribution for amphetamine and methamphetamine, with higher concentrations in the killed drives population), as already explained above.

Table 110. Comparison concentrations in injured and killed driver population

Substance	Injured drivers					Killed drivers				
	Concentrations at or above DRUID cut-off					Concentrations at or above DRUID cut-off				
	Pos	Min.	Max.	Median	Mean	Pos	Min.	Max.	Median	Mean
Ethanol	609	0.10	4.20	1.60	1.59	354	0.10	3.70	1.67	1.61
6-acetylmorphine	1	12.4	12.4	12.4	12.4	0	N.A.	N.A.	N.A.	N.A.
Alprazolam	6	18.5	128	44.5	52.3	15	12.7	100	30	44.8
Amphetamine	45	20	1095	102	215	28	20.3	120000	420	5151
Benzoylecgonine	71	51.6	1500	254	338	7	73	1613	277	483
Clonazepam	30	11.2	174	40.2	45.8	4	10.7	60.9	16.4	26.1
Cocaine	36	10	400	35.5	59.5	3	35	68	50.5	51.2
Codeine	18	10	66.9	20.5	27.1	6	20	731	40	156
Diazepam	41	20	1747	112	234	47	20	1200	200	257
Flunitrazepam	4	5.9	12.1	8	8.5	0	N.A.	N.A.	N.A.	N.A.
Lorazepam	13	12	114	25.6	37.7	4	10	20	20	17.5
MDA	1	43.4	43.4	43.4	43.4	1	273	273	273	273
MDEA	0	N.A.	N.A.	N.A.	N.A.	0	N.A.	N.A.	N.A.	N.A.
MDMA	5	29.3	436	93.9	199	4	300	1511	317	611
Methadone	29	13	581	72	140	1	1231	1231	1231	1231
Methamphetamine	11	22.2	240	125	112	11	40	2939	411	803
Morphine	58	11	898	31.5	65.3	12	11.8	345	53.5	82.3
Nordiazepam	46	27.9	854	138	223	54	20	1600	100	238
Oxazepam	14	55.2	1486	174	303	25	50	2400	300	482
THC	76	1	19.7	2.1	2.9	19	1.1	20.5	3.4	5.2
THCCOOH	121	5	351	23.7	40	11*	6	95	12	25.7
Tramadol	33	55.7	5098	300	596	9	146	2966	605	758
Zolpidem	11	31.6	1161	131	238	6	90	708	250	311
Zopiclone	8	12.0	422	59.6	103	22	10.9	800	60.0	134

3.9.5 Comparison of concentrations between countries

3.9.5.1 Introduction

Box and whisker plots were drawn for substances for which there were at least 20 cases above the DRUID cut-off. This way, differences in the concentration range can be compared between the countries involved in respectively the seriously injured drivers study and the killed drivers study.
The box in these box and whisker plots represents those cases between the 75th and 25th percentile (Q_3-Q_1), whilst the line that bisects the box is the median concentration of the cases. The whiskers that protrude from the box extend to 1.5 times 'Q_3-Q_1' or, if no case has a value in that range, to the minimum or maximum values. If the data are distributed normally, approximately 95% of the cases are expected to lie between the whiskers. Outliers, denoted by a point, are defined as cases that do not fall within the whiskers. Extreme outliers are denoted by squares and represent cases that have values more than three times 'Q_3-Q_1' beyond the limits of the box. It should be remembered that the scale for concentration in the box and whisker plots in this report is in most cases linear, but for some substances the scale is logarithmic base 10. This scale was used in order to facilitate viewing cases with high concentrations whilst not unduly compressing the plot.

3.9.5.2 Injured drivers

Ethanol

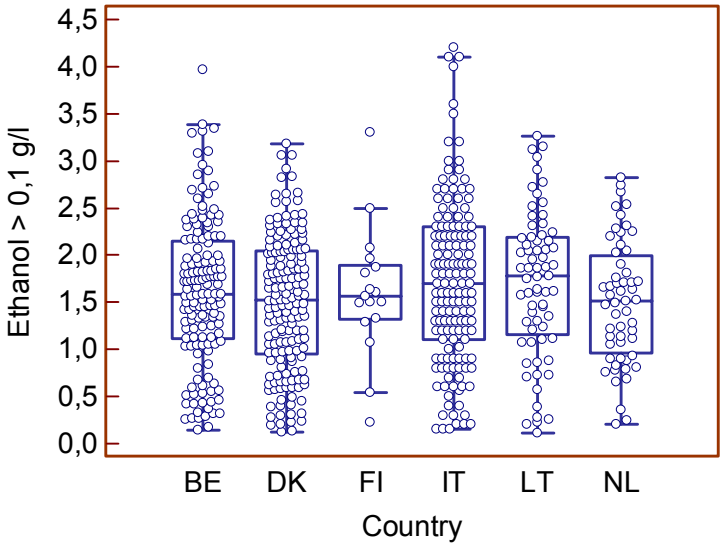


Figure 105. Seriously injured drivers – Distribution concentrations Ethanol

The box plots overlap, which means there was no clear distinction in the distribution of concentrations between the countries.
The widest spread was seen in Italy, with the maximum concentration of 4.20 g/L integrated in the whisker. In Belgium the highest concentration (approximately 4g/L) was seen as an outlier. The median values are very similar among the studied countries.

Amphetamine

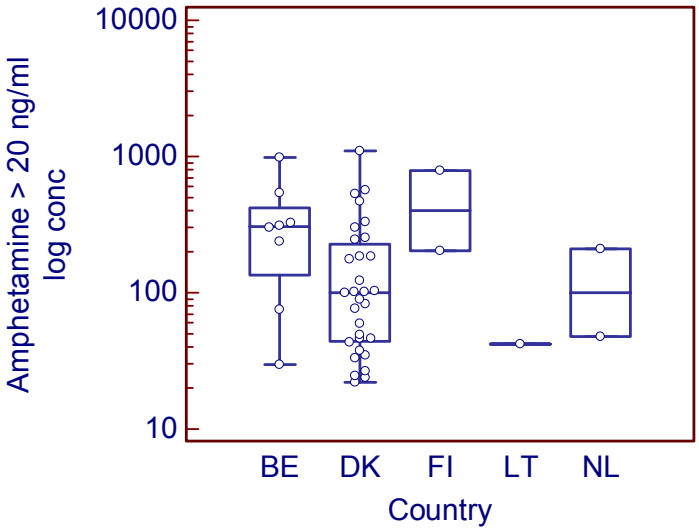


Figure 106. Seriously injured drivers – Distribution concentrations Amphetamine

No driver tested positive for amphetamines in Italy. Since the number of positives in Finland, Lithuania and The Netherlands was very low, no comparison with these countries was made.
The box plots for Belgium and Denmark overlap, which means there is no clear distinction in the concentration distribution. The median concentration although is higher in Belgium than in Denmark.

Benzoylecgonine

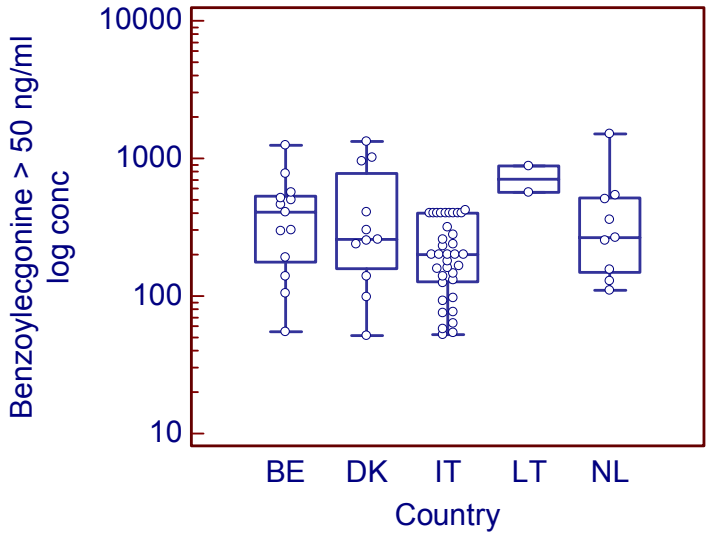


Figure 107. Seriously Injured drivers – Distribution concentrations Benzoylecgonine

Since the number of positives in Lithuania was very low, no clear comparison could be made with this country. For the other countries the box and whisker plots overlap, meaning an equal distribution.
The median concentration in Denmark and The Netherlands is comparable. The median concentration in Belgium was higher.

Clonazepam

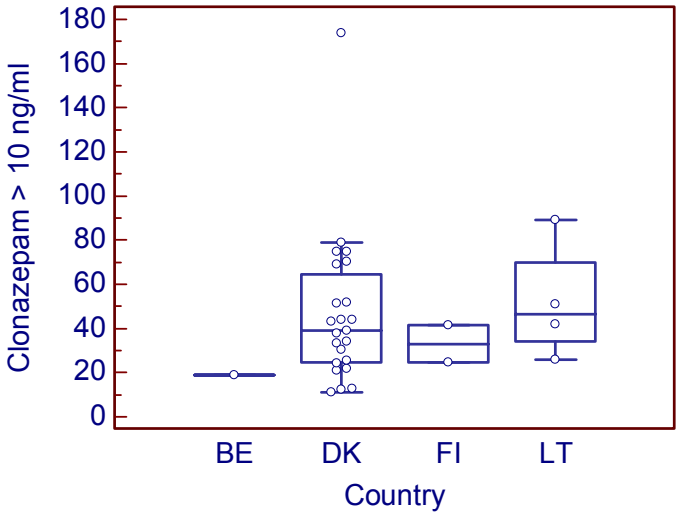


Figure 108. Seriously injured drivers – Distribution concentrations Clonazepam

Since the low number of positives in Belgium, Finland and Lithuania, no comparison for the distribution of clonazepam concentrations could be made. In Denmark 75% of samples testing positive for clonazepam at or above the DRUID cut-off had a concentration below 70 ng/mL.

Cocaine

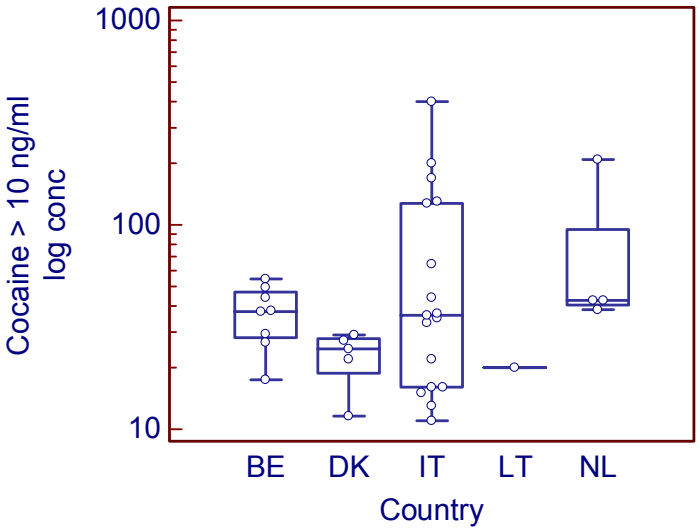


Figure 109. Seriously injured drivers – Distribution concentrations Cocaine

Due to the low number of positives in Lithuania, no comparison with this country could be made. The box an whisker plots for the other countries overlap with Italy, which means there is no clear distinction in concentration distribution. However in this country there is a wide spread for concentration. Among the other countries, concentration range of cocaine

in Belgium and the Netherlands overlap partially, however due to the lower number of positives, a clear comparison could not be made.
In general median concentration did not appear to be comparable, however in Denmark the lowes value was found.

Codeine

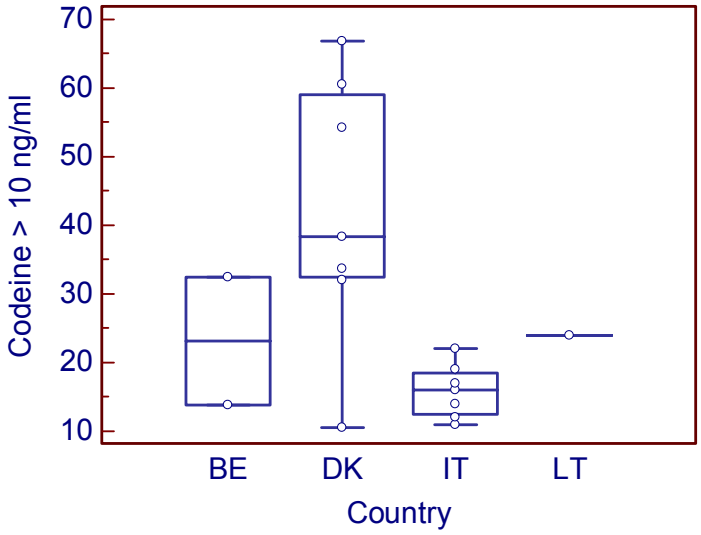


Figure 110. Seriously injured drivers – Distribution concentrations Codeine

Due to the very low number of positives in Belgium and Lithuania, no conclusions were made for these countries. The plots for Denmark and Italy were almost completely separated. Disregarding the lowest outlier for Denmark, a distinction can be made between these two countries: the concentration range in Denmark is higher.

Diazepam

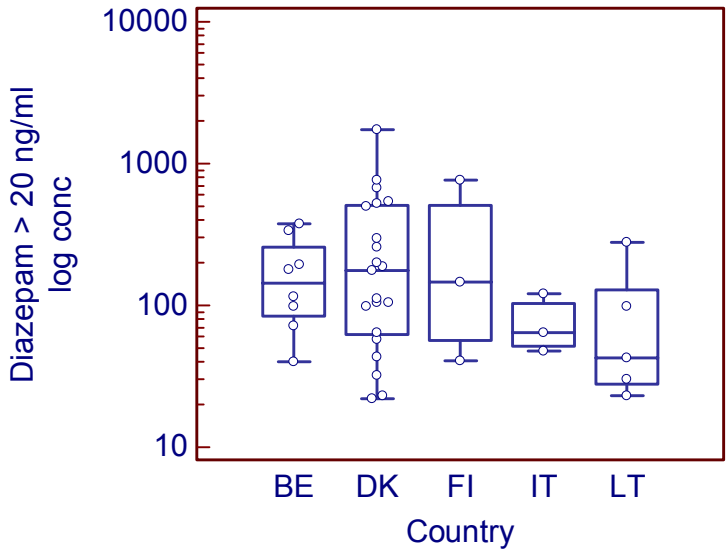


Figure 111. Seriously injured drivers – Distribution concentrations Diazepam

For diazepam the box and whisker plots overlap, indicating that there is no clear distinction in concentration distribution. The maximum concentration was found in Denmark, while the lowest median concentration was found in Lithuania.

Methadone

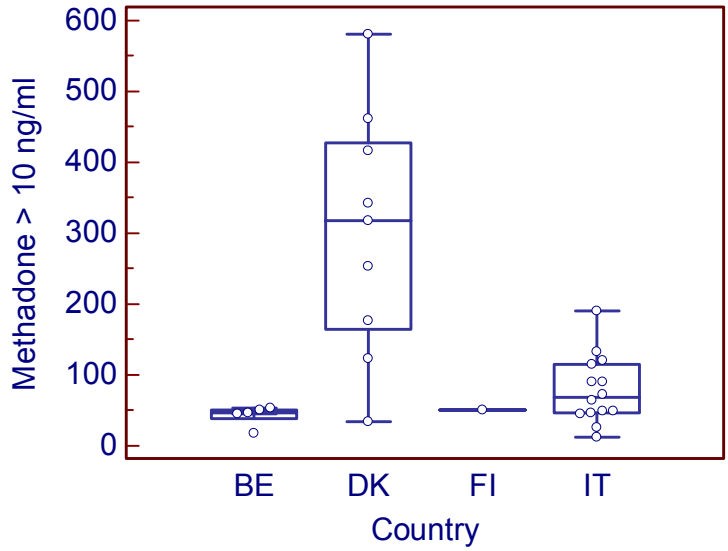


Figure 112. Seriously injured drivers- Distribution concentrations Methadone

The boxes are almost completely separated between Denmark, Italy and Belgium, indicating a different distribution of concentration of methadone. Denmark has the mostly spread range of concentration.

Morphine

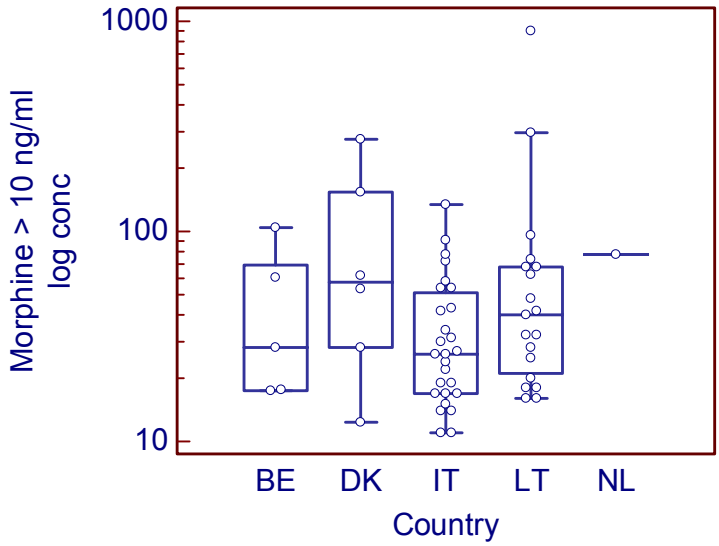


Figure 113. Seriously injured drivers – Distribution concentrations Morphine

Since the number of positives in The Netherlands was very low, no conclusion on that country could be made. All other plots overlap, which means that the distribution of concentration was equal in these countries. The median concentration was higher in Denmark and comparable between Belgium and Italy.

Nordiazepam

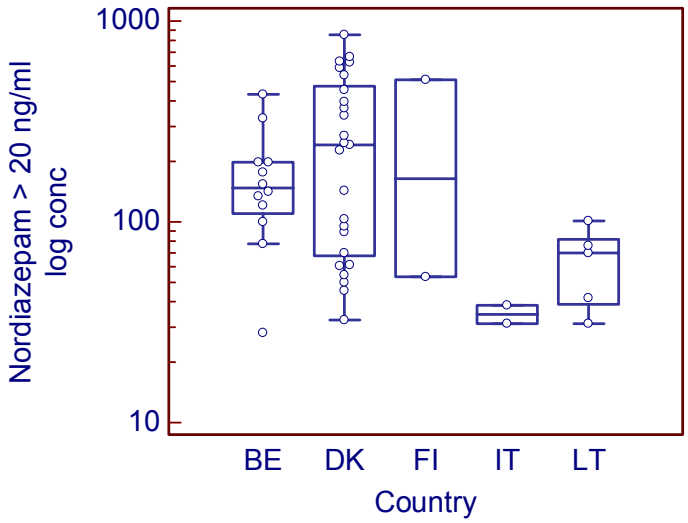


Figure 114. Seriously injured drivers – Distribution concentrations Nordiazepam

Since the number of positives in Finland an Italy was very low, no comparison with these countries could be made. The plots for Belgium and Denmark overlap. The distribution of concentrations in Lithuania were generally lower.

THC

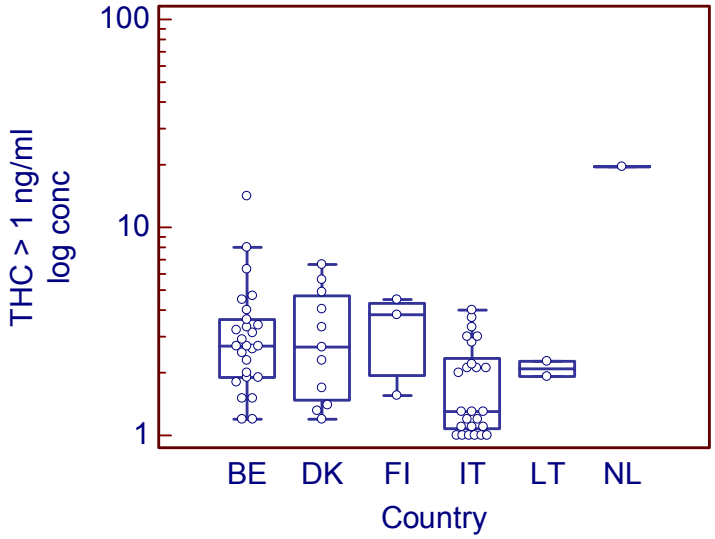


Figure 115. Seriously injured drivers – Distribution concentrations THC

Among all subjects testing positive for THC, only two had a concentration higher than 10 ng/ml. No comparison with Finland, Lithuania and The Netherlands could be made due to the low number of positives. The plots for the other countries overlap, which means that no clear distinction can be made in concentration ranges.

THCCOOH

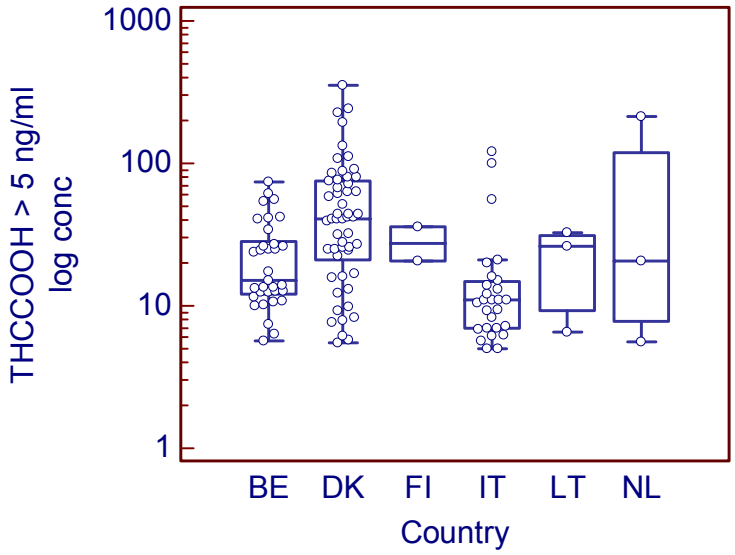


Figure 116. Seriously injured drivers – Distribution concentrations THCCOOH

No comparison with Finland, Lithuania and The Netherlands could be made due to the low number of positives. For the other plots the median is different. The highest median concentration was found in Denmark, the lowest in Italy. Since the plots overlap, distribution of concentration was found comparable. In Italy 3 outliers were defined. Only

few subjects had a THCCOOH > 75 ng/mL, which is considered to be a criterion of chronic use in Germany.

Tramadol

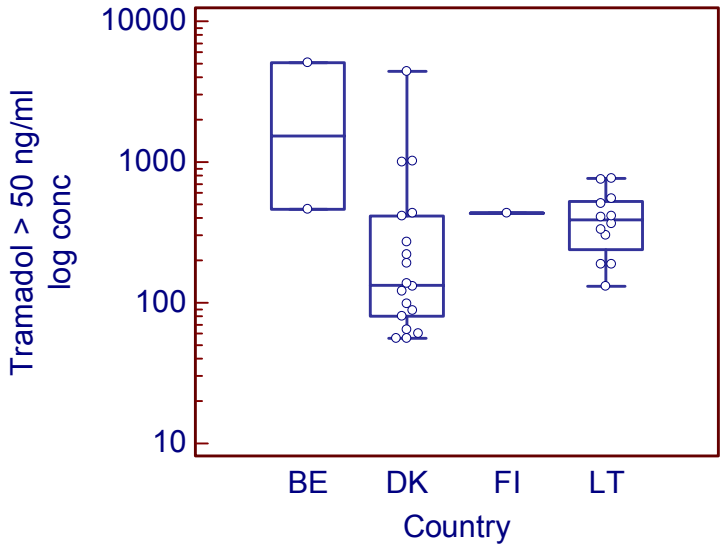


Figure 117. Seriously injured drivers – Distribution concentrations Tramadol

Due to the low number of positives in Belgium and Finland, no comparison could be made with these countries.
The plots for Denmark and Lithuania overlap, meaning a similar distribution of concentration in these countries. The median concentration in Denmark was lower compared to Lithuania.

3.9.5.3 Killed drivers

Ethanol

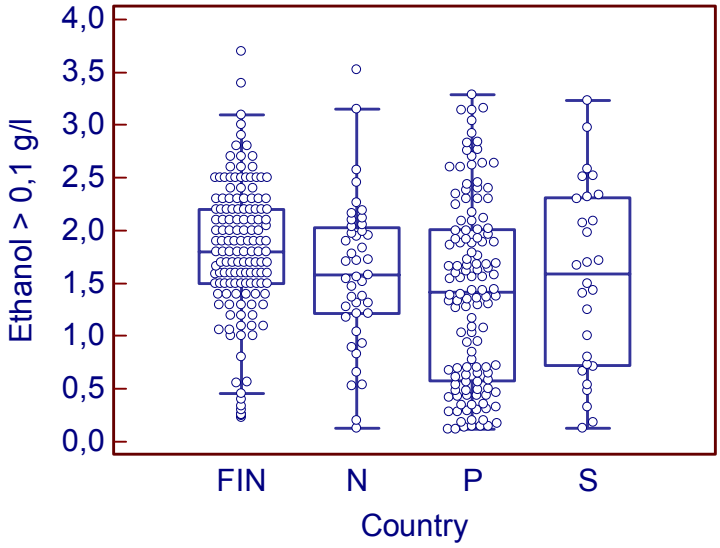


Figure 118. Killed drivers- Distribution concentrations Ethanol

Note: FIN= Finland; N= Norway; P=Portugal; S= Sweden

For ethanol the highest maximum concentration (3.70 g/L) was found in Finland as well as the highest median concentration; the lowest in Portugal. The median concentration for ethanol was similar in Norway and Sweden, however the inter-quartile range was wider in Sweden compared to the one of Norway.

Amphetamine

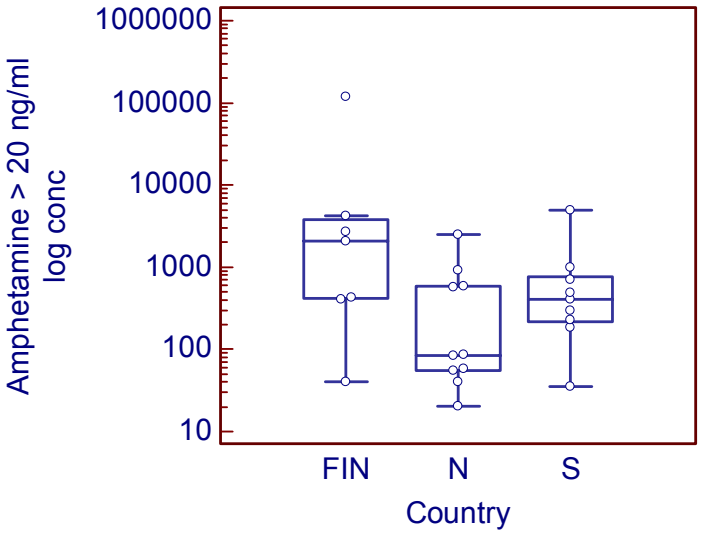


Figure 119. Killed drivers – Distribution concentrations Amphetamine

Note: FIN= Finland; N= Norway; P=Portugal; S= Sweden

The highest concentrations for amphetamine was found in Finland, the lowest in Norway. In Sweden the concentrations were more equally spread in comparison to Finland and Norway. The mean concentration of Norway was much lower than those in Finland and Sweden (below 100 ng/mL). There was an overlap between the boxplots which means there was no clear distinction in the distribution of concentrations between the countries.

Diazepam

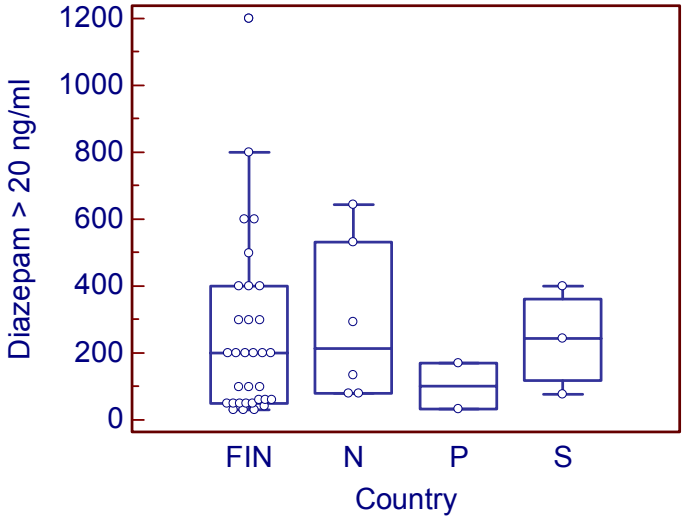


Figure 120. Killed drivers – Distribution concentrations Diazepam

Note: FIN= Finland; N= Norway; P=Portugal; S= Sweden

Due to the low number of positives in Portugal and Sweden, no comparison could be made with thes countries. Finland had the higher number of observations and the widest spread of concentrations of diazepam including the maximum value recorded (1200 ng/ml). The median concentrations were similar for Finland and Norway.

Nordiazepam

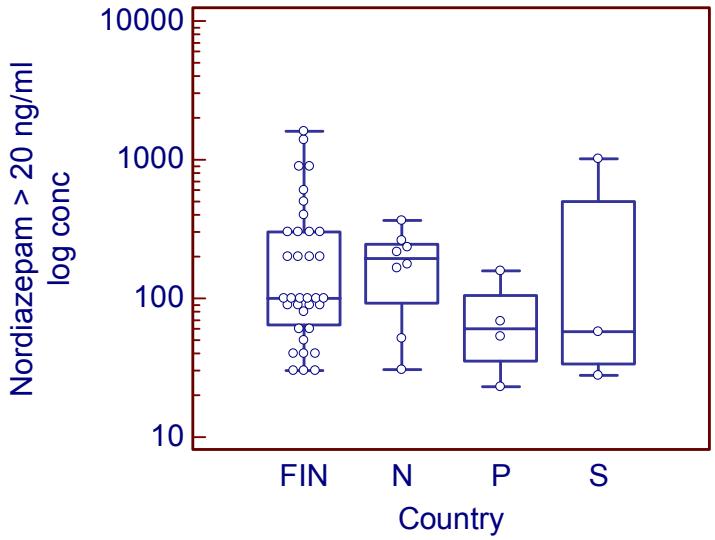


Figure 121. Killed drivers – Distribution concentrations Nordiazepam

Note: FIN= Finland; N= Norway; P=Portugal; S= Sweden

Due to the low number of positives observed for nordiazepam in Portugal (4) and Sweden (3), no conclusion can be drawn. For Finland and the Netherlands the boxes were overlapping, meaning no clear distinction in distribution of concentration. The highest concentrations of nordiazepam was found in Finland. In Norway the median concentration of nordiazepam was higher than in Finland.

Oxazepam

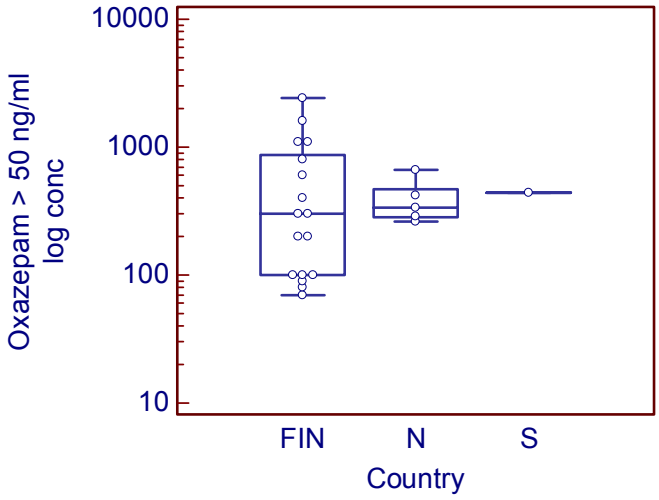


Figure 122. Killed drivers – Distribution concentrations Oxazepam

Note: FIN= Finland; N= Norway; P=Portugal; S= Sweden

There were no positive cases for oxazepam in Portugal and only one in Sweden. The boxes for Finland and Norway overlap, however the number of observations in Finland was higher probably leading to much more spread concentration values. The median concentrations were relatively similar in Finland and Norway.

THC

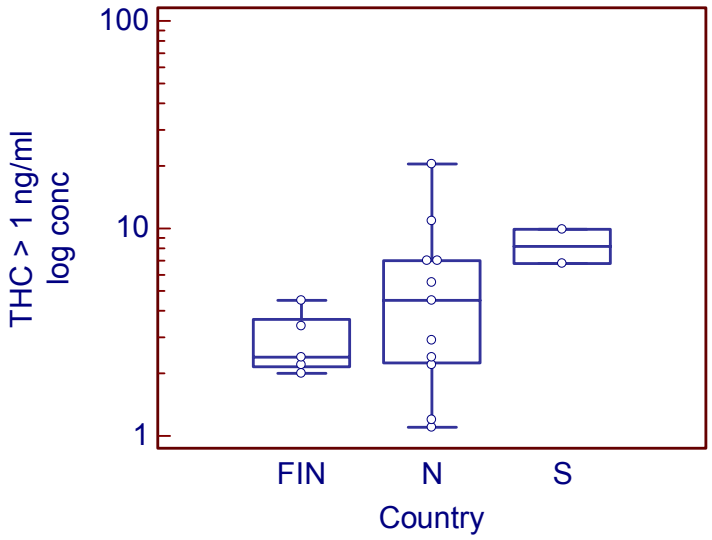


Figure 123. Killed drivers – Distribution concentrations THC

Note: FIN= Finland; N= Norway; P=Portugal; S= Sweden

Only two cases positive for THC were observed in Sweden, not allowing to make any comparison with this country. The widest spread of concentration was found in Norway. The boxes are overlapping, indicating similar concentrations in the two countries.

4 Discussion

In the present study, data about subjects injured or killed in road traffic accidents during the years 2006-2010 were collected across nine European countries. Information gathered included data relative to the driver, the time and type of accident and the toxicological findings in a blood sample, collected from the driver after the accident, and analysed for a representative group of psychoactive substances that may affect the ability to drive. This result chapter analysed data relative only to drivers of cars and vans.

Data about seriously injured drivers were collected in Belgium, Denmark, Finland, Italy, Lithuania and The Netherlands, during different time frames between October 2007 and April 2010.
Data about killed drivers were collected in Finland, Norway, Portugal and Sweden, between January 2006 and December 2009, with different collection periods in the four participating countries.

The non response in the six countries varies between 0% and 8.5% for the surveys on the injured drivers. For the studies on killed drivers the missing cases varied between 5.7 - 41%. In Norway the police was in charge for sending samples to the laboratory responsible for analysis. When the police considered that the probability of finding alcohol or drugs was low, no samples were sent to the laboratory. This procedure can be an explanation for the high percentage of missing cases.

Concerning the representativeness of the population in the EU countries and the representativeness of the hospitalised and killed driver sample. The Southern EU Member States are the best represented (54%), followed by the Northern Member States (29%). Every country made several efforts to have a representative driver sample, resulting in a high participation rate in the injured driver surveys and in a low number of missing cases in most of the countries involved in the killed driver study.

When grouping the samples by quarter of the year, in the seriously injured drivers study, the percentages of samples collected during the first and the fourth quarters appeared to be more represented. The significant difference recorded may be due to the fact that collection campaigns in the six participating countries started and ended at different times, not covering exactly the same time frames. On the whole sub-population in the killed drivers study, more samples appeared to have been collected during the third and fourth quarter of the year, however no significant difference was found in the sample distribution across the four quarters of the year in the four participating countries.

In both studies, the distribution of sampling along the week time periods showed that the percentage of accidents recorded during daytime was higher than the one recorded during nighttime, with more than half of the accidents occurring during a weekday and approximately one quarter during a weekend day. In both studies and all countries, except for The Netherlands, the percentage of accidents decreased in the order weekdays, weekend days, weekend nights and weeknights (in The Netherlands: weekday, weeknights, weekend nights and weekend days). While in the seriously injured drivers study significant differences were found in the sample size collected during the different aggregated time periods, no significant difference was found in the sample size collected in the killed driver study.

In both studies significant differences were found between both gender and age groups. In general, the prevalence in males was higher than in females, with a percentage ratio approximately 70/30 in the seriously injured drivers and 83/17 in the killed drivers.

The age group distribution was different in the two studies, with the age group 50 and above accounting for approximately 19% of the sample in the injured drivers study and approximately 36% of the sample in the killed drivers study.
In men, the two first age groups, 18-24 and 25-34, accounted for approximately 55% of the sample in the injured drivers study, and for approximately 42% of the sample in the killed drivers study. For the same two female age groups, the distribution was approximately equal to 49% in the seriously injured drivers study and to 32% in the killed drivers study.

In both studies, among accidents for which type was recorded, the percentage of multi-vehicle was higher than single-vehicle accidents, being the ratio approximately 54/46 in the seriously injured drivers study, and 58/42 in the killed drivers study.

Findings from the toxicological analysis have been presented in two sets of data, one giving an overview of the number of drivers using the different substance groups (prevalence of use) and in mutually exclusive groups. It has to be noted that in both analyses a sample was considered positive if a substance was found at or above the set DRUID cut-offs. For this reason, the data give an estimate of the prevalence of substance groups among the sampled population, which is likely to be conservative, because samples tested positive below the set cut-off were considered as negative.

As expected, alcohol was the most common toxicological finding, both in the seriously injured and in killed drivers. The highest percentages were recorded for alcohol in both sets of data: prevalence of use and mutually exclusive groups. Alcohol was the only substance among the ones tested for that appeared more often alone than in combinations. When alcohol was combined with other drugs, benzodiazepines and cannabis, in the form of THC and/or THCCOOH, were the most common associated findings. This happened in both studies, even if in the killed drivers study the prevalence of cannabis use may have been further underestimated due to the fact that Norway and Finland did not analyse for the presence of THCCOOH.

In the prevalence of use, among all seriously injured drivers, after alcohol, cannabis, detected as THC and/or THCCOOH, and benzodiazepines were the most common findings. Use of these psychoactive substances appeared in both gender and all age groups.

In the killed drivers study, among all sampled subjects, the most prevalent substances after alcohol were benzodiazepines, followed by amphetamine and cannabis. The total number of findings for amphetamine (33 at or above DRUID cut-offs) was slightly higher than the one for cannabis (29), however, as already mentioned, the use of cannabis may have been underestimated in the killed drivers study because THCCOOH was not measured in two countries. It has to be noted that out of the four participating countries in the killed driver study three, Finland, Norway and Sweden, are part of the Scandinavian area where the use of amphetamines is generally higher than in the southern European countries.

Belgium, Denmark and Finland had the highest percentage of subjects positive for cannabis among the seriously injured drivers, while in the killed drivers study the highest percentages were found in Norway and Portugal. Although still present, in general, use of cannabis appeared to decrease in the age group 50 and above.

Benzodiazepines use was present in both gender and all age groups, with higher percentage of positive findings recorded in Finland, Belgium and Denmark, in the seriously injured drivers study, and in Finland, Norway and Sweden, in the killed drivers study. The diffusion of this substance group among both gender and all age groups may

be explained by the various therapeutic uses, different benzodiazepines being prescribed, among others, for the treatment of anxiety disorder, sleeping disorders and epilepsy.

In the prevalence of use, the other substance groups appeared with more different patterns in the participating countries.

Among the illicit drugs, amphetamine use appeared to be more common in northern Europe, with the highest percentages of positive findings recorded in Denmark, followed by Finland, Belgium and The Netherlands in the seriously injured drivers study. In the killed drivers study, the highest percentages of amphetamines use were recorded in Norway and Sweden. Cocaine use seemed to be more prevalent in the southern Europe, with Italy and Portugal having the highest percentages of subjects testing positive for cocaine and/or benzoylecgonine in the seriously injured and killed drivers study respectively. Finland was the only country in which no case of cocaine use was recorded, both in the seriously injured and in the killed drivers study. Cases of illicit opiates use were recorded only in the seriously injured drivers study and only in Belgium, Denmark, Italy and Lithuania. In general the use of these three groups of illicit drugs tended to decrease, if not disappear, in the older age group (50 and above). Use of cocaine and amphetamines appeared somehow more common in the youngest age groups, up to 34 years, while illicit opiates use seemed more common in the age groups 25-34 and 35-49.

Use of Z-drugs appeared to be more common in northern Europe, with the highest percentages of cases recorded in Finland, followed by Belgium and Denmark in the seriously injured drivers study, and in Norway followed by Sweden and Finland in the killed drivers study. Use of these medications was recorded in both genders, and apparently more frequent in the older age groups starting from 35 years.

In the prevalence of use the medicinal opioids group appeared to be relatively equally distributed in both genders and all ages. In the seriously injured drivers the highest percentage of positive subjects was found in Lithuania, with 7.8% of the cases testing positive for at least one medicinal opioid. In the other countries involved in the seriously injured drivers study, percentages of prevalence of use for medicinal opioids ranged from 4.2 in Denmark to 0.5 in the Netherlands. In the killed drivers study the highest percentage of positive findings for medicinal opioids was found in Sweden at 4.1%, with the other countries recording percentages around approximately 2%.

Apart from alcohol, all other substance groups appeared more often in combination with other drugs or alcohol than alone, in percentages that may vary from approximately 50% up to 100% of the cases, for different substance groups and in different countries.

In the mutually exclusive groups, percentages of positive drivers varied from around 28% up to 53% in the different countries. Both, highest and lowest percentages of positive drivers, were recorded in the seriously injured drivers study, with Belgium having 52.6% positive drivers among the sampled population and Lithuania 27.8%. In the killed drivers study, the highest percentage was found in Portugal, with 47.7% of drivers testing positive for at least one of the mutually exclusive groups. The lowest percentage was found in Sweden, with 30.5% of positive drivers.

“Alcohol alone” and “alcohol-drug” combinations represented the most common groups in the mutually exclusive groups in both studies and all countries apart from Lithuania, where the second most common group was the one of “medicinal opioids”. In the killed drivers study, for Sweden the same percentage of positive drivers was recorded in both, the “alcohol-drug” combination group and the “drug-drug” combination group. The distribution of mutually exclusive groups was then less homogeneous in different

countries and in the two studies. However for Belgium, Denmark, Finland and Italy, in the seriously injured drivers study, and for Norway, in the killed drivers study, the “drug-drug” combination group was the third for percentage of drivers included.

In general more positives were found among males than females. In both studies, in the male group, the group aged 25-34 was the one that had the highest percentage of positive subjects. This happened in all countries apart from Lithuania, in the seriously injured drivers, where the age group 50 and over presented a higher percentage of positives, and in Finland, in killed drivers, where the age group 18-24 was the one recording the highest percentage of positive subjects. In the female group distribution of positives was somehow less regular and, in both studies, the highest percentages were found in different age groups.

As for time periods, in both studies, higher percentage of positives were normally found among drivers involved in accidents occurred at night time, either during the week or the weekend, compared to percentages of positive drivers found among subjects involved in accidents during daytime. Lithuania was the only country in which the lowest percentage of positive drivers was found during week nights.

Although, as reported, the percentage of drivers involved in multiple-vehicle accidents was higher than the one involved in single-vehicle accident, percentage of positive subjects was higher in single-vehicle accident in both studies, with a ratio of at least 1.5:1 in the seriously injured drivers, and 1.8:1 in killed drives. In most cases the ratio is > 2.

In the seriously injured drivers study, the distribution of concentrations, when all recorded values were considered, showed that median and mean were above the DRUID cut-off for almost all substances. In the killed drivers study, median and mean concentrations obtained considering all recorded values were above the DRUID cut-off for all substances apart from flunitrazepam.

Regarding the distribution of alcohol concentration, 24.4% of the injured drivers population was positive for alcohol. 65.7% of them had a BAC ≥ 1.3 g/L. In the killed drivers population 31.7% was positive for alcohol. 70.6% of them had a BAC ≥ 1.3 g/L.

Comparing the DRUID-results with data from previous studies conducted on injured drivers (see table 111), the following conclusions could be drawn:
- DRUID alcohol prevalence was higher than in the Australian study and lower than the percentages found in the United States or South-Africa.
- More positive findings for the combination alcohol-drug were found than in the Australian study. On the other hand DRUID-prevalence for this substance group was lower than found in the American study of 2005.
- The percentage of amphetamine positives within DRUID was higher. This could be explained by the inclusion of Northern European countries that have a higher prevalence of use, which was supported by the fact of a similar percentage of amphetamine positive findings in the Danish study (2005).
- The prevalence of cocaine was much lower than in the United States.
- The percentage of drivers positive for cannabis was lower in DRUID except for the Danish and Dutch studies conducted in 2005.
- The prevalence of benzodiazepines was lower than in one of the American and both French studies.
- Opiate use is quite similar, except for two of the American studies where higher percentages were seen.

Comparing the DRUID-results with data from previous studies conducted on killed drivers (see table 112), the following conclusions could be drawn:
- DRUID alcohol prevalence was lower than in the American, Italian and Spanish studies. It has to be noted that Italy and Spain were not involved in the DRUID study.
- The prevalence of drug use was lower except for the study conducted in Hong Kong
- More positive findings for the combination alcohol-drug were found than in the studies in Hong Kong and Sweden. On the other hand DRUID prevalence for this substance group was lower than found in the American, Italian, Canadian and Australian studies.
- The percentage of amphetamine positives within DRUID was lower except for the Spanish, Italian and Canadian studies.This confirmes the lesser amphetamine use in Southern Europe
- The prevalence of cocaine was lower than in the other studies. This could be explained by the fact that only one Southern European country was involved in the DRUID study amongst four Northern countries, where the use of cocaine is known to be lower. This conclusion could be supported by the fact of a similar prevalence found in the Swedish study in 2005.
- The percentage for positive findings for cannabis is lower in DRUID except for the studies conducted in Spain and Hong Kong
- The prevalence of benzodiazepines was higher except for the Canadian study where a similar percentage was found.

Perspectives/Recommendations
- It is recommended (if there is enough funding) to include more countries and hospitals to get a better European overview.
- It can be recommended to collect saliva samples in hospital studies to be able to make better comparisons with saliva samples collected in road side surveys, were it is known to be more difficult to collect blood samples (see D2.2.3). It was performed in Finland and this shows that it is feasible. However, when requested to take saliva samples from seriously injured drivers, hospitals in Denmark refused.
- Guidelines and legislation regarding ethical issues in studies with human subjects can hamper the survey. The need of a written informed consent makes the patient less inclined to participate.
- This study emphasised the importance of the chosen study design and protocols. For example in the killed drivers study the collaboration with police forces was needed to get essential information. A recommendation for future research is to establish a good communication and collaboration with all partners involved in the survey. The working group on alcohol, drugs, medicines and driving of DG Move has recommended that in all EU member states, all killed drivers have a toxicology screening. This is performed in the Scandinavian countries, but not elsewhere. In the Netherlands this is impossible, because of the fear that insurance companies would misuse the results to refuse reimbursement.
- The study showed how difficult it is to collect samples from injured drivers in hospitals, as collecting study samples is not the priority of emergency personnel. The importance of staff specifically assigned to the study in the hospitals was underlined. It was seen that hospitals who had such a key person collected more samples and that this contact person was essential for a good follow-up.
- One of the inclusion criteria applied was that the injury severity had to be MAIS 2 or higher. When analysing the data it became clear that a lot of injured drivers in different countries had a lower injury severity. In future research it should be considered to include also MAIS 1, because there are fewer seriously injured drivers expected than in the past.
-In this study it was chosen to use LCMSMS or GCMS for the analysis of blood. This restricted the amount of substances to be searched for, e.g. not all benzodiazepines were analysed for. Future studies should consider using more broad-spectrum methods such

as immunoassays for some drug classes like benzodiazepines. The emergence of new designer drugs like mephedrone, piperazines, spice, etc. brings new challenges.
- Attention should be paid to the collection of data of patients that refused to participate and patients that were missed. This is needed in order to be able to examine refusal rates and to see whether they introduce bias.
-Attention should also be paid to the recording of drugs administered prior to sampling and to the interval between time of accident/time of death and the time the sample is taken. These were not reported in all cases in our study, and some manual corrections were necessary.

Table 111. Prevalence of drugs, medicines and/or alcohol in seriously injured drivers (percentage)[15]

	Country									
	Australia	**Denmark**	**France**		**Netherlands**	**South Africa**	**United States**			**BE, DK, FI, IT, LT, NL**
Study	Longo et al. (2000a)	Bernhoft et al. (2005)	Kintz et al. (2000)	Mura et al. (2003)	Assum et al. (2005)	Sukhai (2004)	Soderstrom et al. (2001)	Lowenstein and Koziol-McLain (2001)	Walsh et al. (2005)	DRUID 2010
Year(s)	1995-1996	2002-2004	1999	2000-2001	2000-2004	1999-2001	1994-1996	1995-1996	2003	2007-2010
Sample size	2 500	330	198	900	184	/	748 (A)	414	108	2450
							500 (D)			
Sample	blood	blood and/or	blood	blood	blood or urine	/	blood	urine	blood (A)	blood
		saliva							urine (D)	
Remarks					weighted results					
Alcohol detected	11.0		13.6			45.2	30.0		30.6	24.4
≥ 0.1 ‰										24.4
> 0.2 ‰					18.6 (*)					
> 0.4 ‰								13.8		
≥ 0.5 ‰	10.3				17.4 (*)					22.1
> 0.8 ‰	9.2				15.2 (*)					
Drugs						34.1			50.9	15.2
Drugs + alcohol	1.4					19.5			15.7	5.8
≥ 0.1 ‰										5.8
> 0.2 ‰	1.2				10.4					

[15] Source: Raes E, Van den Neste T, Verstraete A, EMCDDA Insights: Drug use, impaired driving and traffic accidents: Table A2 p135

≥ 0.5 ‰	1.0			3.8	8.9					5.3
> 0.8 ‰					8.4					
Drug + drug										2.4
MDEA	0.04									0.0
Amphetamine	0.2	1.5		0.7			0.0	0.7	0.9	1.6
MDMA			0.5							0.2
MDA										0.0
Methamphetamine	0.7								5.6	0.4
Cocaine		0.6	0.5	0.1			18.7	3.6	10.2	2.9
Cannabis	7.1	3.3	9.6	10.0	3.4 (*)		9.6	16.9	26.9	5.3
Benzodiazepines	1.8	3.0	6.1	14.0	3.6 (*)			1.2	11.1	4.3
Opiates		1.8		2.7			23.7	1.5	10.2	
morphine					0.5 (*)					1.5
heroin			0.5							0.9
codeine			1.5		1.0 (*)					0.3
Methadone								0.2	5.6	1.1
Tramadol										1.3
Barbiturates								1.0	3.7	
Norephedrine			0.5							
Antidepressants				1.8						
Propoxyphene								1.5		

(*): only this substance present, no combinations / A: alcohol / D: drugs

Table 112. Prevalence of drugs, medicines and/or alcohol in killed drivers (percentage)[16]

	Country											
	Australia	**Canada**	**France**	**Hong Kong**	**Italy**		**Spain**		**Sweden**	**UK**	**US**	**FI,NO, PO, SE**
Study	Drummer et al (2005)	Brault et al (2004)	Mura et al (2006)	Cheng et al (2005)	Sironi et al (1999)	Vignali et al (2001)	del Rio et al (2002)	Lopez-Rivadulla and Cruz (2000)	Holmgren et al (2005)	Assum et al (2005)	Logan and Schwilke (2004-05)	DRUID 2010
Year	1990-1999	1999-2002	2003-2004	1996-2000	1986-1996	1997-1999	1991-2000	1996-1998	2000-2002	1998-2002	2001-2002	2007-2010
Sample size	3398	855	2003	197	129	119	5745	33	855	22	370	1050
Sample	blood	blood and urine	blood	blood (A), blood and urine (D)	blood (A), blood and urine (D)	blood	blood	blood and urine	blood and urine	blood	blood and serum	blood
Alcohol	>0.5 ‰: 29.1	33.5		>0.5‰: 24.9	55.8	47.9	43.8	58.9	>0.2‰: 22.2	36.4	44.0	32.8
		>0.8‰: 28.5			>0.1‰: 48.1		>0.8‰: 32.0					≥0.5‰: 28.6
Drugs	26.7	24.7		6.1		21.9						15.6
Illicit							8.8		8.1			
Medicinal							4.7		19.4			
Drugs + alcohol	9.7	11.7		2.5		16.0	5.6	7.0	>0.2‰: 4.9		17.0	6.6

[16] Source: Raes E, Van den Neste T, Verstraete A, EMCDDA Insights: Drug use, impaired driving and traffic accidents: Table A3 p136-7

				>0.5‰: 2.0								≥5‰: 5.9
Drug + drug												2.5
Amphetamine	4.1	0.4	3.1			0.0	1.2		5.2	4.6	4.9	1.6
Methamphetamine				1.5					0.8			1.0
MDMA				1.5		0.0	0.6		0.9			0.4
MDA					0.8							0.0
Cocaine		4.7	3.0		4.7	8.4	5.2		0.5		3.5	0.7
Cannabis	13.5	13.1	28.9	2.0	4.7	8.4	2.2		3.9		12.7	2.9
Benzodiazepines	4.1	9.2		1.0	3.9	5.9	3.4		7.6	Diazepam: 4.6	4.1	8.4
Opiates	4.9	1.3	1.9			3.4	3.2			4.6	1.6	1.7
Methadone					3.9	0.8			0.1			0.1

A: alcohol / D: drugs

5 References

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Annex 1 Guidelines for the study and the data collection[17]

The study population was achieved by 'multistage sampling'. First a selection of hospitals was made. Secondly, only patients that match a number of well-defined inclusion criteria were selected.

Selection of hospitals

Different criteria were considered for the selection of the hospitals.

- willingness to cooperate
- geographical distribution. This is especially important when roadside surveys were organised in the hospital catchment areas in order to increase representativeness of the roadside survey.
- Influx of injured drivers. A small amount of large hospitals was preferred over a large number of small hospitals (with better geographical distribution) because the data collection was easier to control.

Once a first selection of hospitals was made, it was recommended to perform pilot tests in each hospital over a limited period of time (e.g. 2 weeks). The number of incoming injured drivers was recorded including information concerning the inclusion criteria. These data could be extrapolated to the expected duration of the study to see if the desired sample size could be obtained. If necessary, the number of hospitals could then be adjusted.
Each partner had to check if approval of the ethical committee of the hospitals and informed consent of the patients was necessary.

Hospital personnel

It was advised to have dedicated personnel present in each hospital, eg a local supervisor (MD) and a local coordinator (nurse). A researcher would regularly visit all hospitals to check for problems and made changes if necessary.
Each hospital received a detailed manual explaining all aspects of the study (e.g. inclusion criteria, data to be gathered and correct interpretation of all forms).

Inclusion criteria

It was necessary to define precise inclusion criteria for the subjects. To increase homogeneity across Europe, it was preferred that these were the same in all countries. However, due to practical and legal issues, national differences might have been necessary. Therefore two lists of criteria were made: a first list of inclusion criteria that all countries needed to comply with and an additional list of criteria on which countries could decide for themselves.

Recommendations

Deviations from these inclusion criteria had to be substantiated and approved by the Task and WP leader
Obligatory inclusion criteria:

- Driver of a motorised vehicle
- Injured in accident on a public road or in the direct vicinity of a public road

[17] Source: D2.1.2: Working paper "uniform design and protocols for carrying out case-control studies"

- Only primary admissions, not patients transferred from other hospitals
- Admissions because of traumatological reasons
- Time interval between accident and sampling had to be less than 3 hours
- Severity of injuries: MAIS (Maximum Abbreviated Injury Scale) 2 or higher

National inclusion criteria (each country decided whether to apply these criteria):

- Inclusion of injured bicycle riders
- Age. It was suggested to include only drivers older than 18, since informed consent was easier to obtain
- Inclusion of drivers killed on the spot. In most countries this was not possible due to practical or legal reasons
- Inclusion of foreign drivers. This was recommended since the study investigated the driving population within a country an not only the native driving population
- Inclusion of professional drivers

Minimum data to be gathered

The data that could be obtained were limited because of the low accessibility of the patients (e.g. short stay in hospital, unconsciousness, deceased in hospital,…) and practical concerns from the hospital staff.
Therefore it was advised to collect only a limited number of data which had to be standardised across Europe. The minimum data to be gathered could be divided into three groups:

- Toxicological information: the substances and analytical cut-offs have been standardised across Europe
- Patient information
  - Identification number (for labeling of samples and recorded data)
  - Age
  - Gender
  - Time + date of sampling
  - Medication/fluids administered prior to blood sampling
  - Severity of injuries: MAIS
- Accident data
  - Time + date
  - Type of vehicle
  - Single vehicle accident: yes/no
  - Driver's license: yes/yes, but suspended/no
  - Professional use of vehicle: yes/no (only if professional drivers were included)

If possible, more information was gathered in each country, e.g. the degree of damage to the vehicle.

Collection of patient information

The questioning of the patient was preferably done face-to-face. If this was impossible (e.g. patient remains unconscious), partial information could be gathered from other sources (e.g. medical record). It was stressed that the questionnaire should be anonymous. Consequently, non-response could be reduced to a minimum.
When patients refused to cooperate with the study, the reason had to be recorded.
Proxy-informants were allowed to give certain information, if patients were unable to answer.

Protection of patient information

All necessary procedures were applied to guarantee the privacy of the patient and the confidentiality of the doctor-patient relation:

- All information was gathered under supervision of an MD
- No references about the inclusion of a patient in the study could be made in the medical files of the patient
- The blood samples gathered for this study were treated in a separate procedure and could never be used for clinical or forensic purposes.
- The toxicological analysis and data processing were done anonymously. All forms and samples were given a unique and anonymous code, of which only the local coordinator had the key. An additional coding was performed in the centre where all data are centralised; the files containing the decoding keys had to be password-protected.
- The results of the analysis could not be given to anyone outside the laboratory and the responsible partner for data processing.

Collecting of accident information

Collection of accident information would in some countries require cooperation between the police and researchers. This was not always easy since the principles of police work were different from those of the research. Since the terms of the cooperation depended on the local situation, each partner had to check with the police how this had to be organised. Points of particular interest were reliable collection of data and guaranteeing the anonymity of the patients included in the study.

Time frame

Both traffic accidents and the prevalence of psychoactive substances may vary by time. Consequently, the roadside surveys had to cover all year, all week and all day. Since the same logic applied to the hospital study, the time frame for collection of samples in both studies had to be the same.
Week and weekend – day and night was defined in the following 8 time intervals of the week to ensure comparability:

Table 113. DRUID-time periods

Weekdays	Weekend
1. Monday to Friday 04:00 to 09:59	5. Saturday and Sunday 04:00 to 09:59
2. Monday to Friday 10:00 to 15:59	6. Saturday and Sunday 10:00 to 15:59
3. Monday to Thursday 16:00 to 21:59	7. Friday to Sunday 16:00 to 21:59
4. Monday to Thursday 22:00 to 03:59	8. Friday to Sunday 22:00 to 03:59

Annex 2 Seriously injured drivers- Distribution of positive drivers- Mutually exclusive groups

Table 114. Seriously injured drivers – Distribution of positive drivers – Amphetamines only

Mutually exclusive group - Percentage of drivers positive for AMPHETAMINES ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	1.8	2.3	0.0	0.9
Denmark	1.1	3.6	0.0	0.0	0.0	1.3
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	0.0	0.0	0.0	N.A.	0.0
Lithuania	0.0	0.0	1.5	0.0	0.0	0.4
The Netherlands	0.0	2.6	0.0	0.0	N.A.	0.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	5.9	0.0	0.0	0.0	0.0	1.1
Denmark	1.3	0.0	0.0	0.0	0.0	0.3
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	0.0	0.0	0.0	N.A.	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	8.3	0.0	0.0	N.A.	2.7
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

Table 115. Seriously injured drivers – Distribution of positive drivers – Benzoylecgonine only

Mutually exclusive group - Percentage of drivers positive for BENZOYLECGONINE ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	1.0	0.6	1.3	0.0	N.A.	0.8
Lithuania	0.0	1.9	0.0	0.0	0.0	0.4
The Netherlands	0.0	0.0	5.9	0.0	N.A.	1.3
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	2.1	0.0	0.0	N.A.	0.6
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

Table 116. Seriously injured drivers – Distribution of positive drivers – Cocaine only

Mutually exclusive group - Percentage of positive for COCAINE ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	0.6	2.0	0.0	N.A.	0.8
Lithuania	0.0	0.0	0.0	2.4	0.0	0.4
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	0.0	0.0	0.0	N.A.	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

Table 117. Seriously injured drivers – Distribution of positive drivers – THCCOOH only

Mutually exclusive group - Percentage of drivers positive for THCCOOH ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	2.7	0.0	0.0	0.0	0.9
Denmark	2.2	2.1	2.4	1.1	0.0	2.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	2.0	0.6	0.0	0.0	N.A.	0.6
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.0	1.6	1.1	0.0	0.0	0.7
Finland	0.0	0.0	0.0	0.0	N.A	0.0
Italy	0.0	0.0	0.0	0.0	N.A	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	12.5	7.7

Table 118. Seriously injured drivers – Distribution of positive drivers – THC only

Mutually exclusive group - Percentage of drivers positive for THC ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	4.1	2.7	0.0	0.0	0.0	1.7
Denmark	1.6	0.0	0.8	0.0	0.0	0.7
Finland	8.3	0.0	0.0	0.0	N.A.	2.7
Italy	4.0	3.1	0.7	0.0	N.A.	1.9
Lithuania	0.0	0.0	1.5	0.0	0.0	0.4
The Netherlands	0.0	2.6	0.0	0.0	N.A.	0.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	5.9	0.0	0.0	0.0	0.0	1.1
Denmark	0.0	1.6	0.0	0.0	0.0	0.3
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	2.1	0.0	0.0	N.A.	0.6
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

Table 119. Seriously injured drivers – Distribution of positive drivers – Illicit opiates only

Mutually exclusive group - Percentage of drivers positive for ILLICIT OPIATES ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	1.2	1.3	0.0	N.A.	0.8
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	2.1	0.0	0.0	N.A.	0.6
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

Table 120. Seriously injured drivers – Distribution of positive drivers – Benzodiazepines only

Mutually exclusive group - Percentage of drivers positive for BENZODIAZEPINES ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	4.5	0.0	0.9
Denmark	0.5	0.0	0.8	3.4	0.0	0.9
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	0.0	0.0	0.0	N.A.	0.0
Lithuania	0.0	3.8	1.5	7.1	0.0	2.5
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	3.7	10.0	0.0	3.2
Denmark	1.3	1.6	1.1	1.8	20.0	1.7
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	2.1	0.0	7.1	N.A.	1.9
Lithuania	2.8	4.9	0.0	0.0	0.0	2.2
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

Table 121. Seriously injured drivers – Distribution of positive drivers – Z-drugs only

Mutually exclusive group - Percentage of drivers positive for Z-DRUGS ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	0.0	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	2.2	0.0	0.4
Finland	0.0	0.0	0.0	12.5	N.A.	2.7
Italy	0.0	0.0	0.0	0.0	N.A.	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	3.8	N.A.	0.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	0.0	7.4	0.0	25.0	3.2
Denmark	0.0	1.6	0.0	1.8	0.0	0.7
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	0.0	0.0	0.0	N.A.	0.0
Lithuania	0.0	0.0	0.0	0.0	0.0	0.0
The Netherlands	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	0.0	0.0

Table 122. Seriously injured drivers – Distribution of positive drivers – Medicinal opioids only

Mutually exclusive group - Percentage of drivers positive for MEDICINAL OPIOIDS ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	1.4	0.0	0.0	12.5	0.9
Denmark	0.5	0.7	3.2	5.6	0.0	2.0
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	1.0	1.2	2.0	0.9	N.A.	1.3
Lithuania	10.6	3.8	4.5	14.3	0.0	7.6
The Netherlands	0.0	0.0	2.9	0.0	N.A.	0.7
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	0.0	3.8	3.7	0.0	0.0	2.1
Denmark	0.0	3.2	5.7	3.6	20.0	3.4
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Italy	0.0	6.4	3.6	0.0	N.A.	3.2
Lithuania	0.0	2.4	5.3	0.0	0.0	2.2
The Netherland	0.0	0.0	0.0	0.0	N.A.	0.0
UNKNOWN GENDER	Among subjects of the same age group					Among all subjects of unknown gender
	18-24	25-34	35-49	50 and over	Age unknown	
Belgium	N.A.	N.A.	N.A.	N.A.	0.0	0.0
Lithuania	0.0	0.0	N.A.	0.0	12.5	7.7

Annex 3 Killed drivers – Distribution of positive drivers – Mutually exclusive groups

Table 123. Killed drivers – Distribution of positive drivers – Amphetamine only

Mutually exclusive group - Percentage of drivers positive for AMPHETAMINES ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	2.1	0.0	0.0	0.7	N.A.	0.8
Norway	2.4	0.0	3.8	0.0	N.A.	1.5
Portugal	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	3.6	7.7	4.8	0.0	N.A.	2.8
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

Table 124. Killed drivers – Distribution of positive drivers – Benzoylecgonine only

Mutually exclusive group - Percentage of drivers positive for BENZOYLECGONINE ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

Table 125. Killed drivers – Distribution of positive drivers – Cocaine only

Mutually exclusive group - Percentage of drivers positive for COCAINE ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

Table 126. Killed drivers – Distribution of positive drivers – THCCOOH only

Mutually exclusive group - Percentage of drivers positive for THCCOOH ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Portugal	2.4	3.1	0.0	0.0	0.0	1.1
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

Table 127. Killed drivers – Distribution of positive drivers – THC only

Mutually exclusive group - Percentage of drivers positive for THC ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	2.4	7.7	0.0	0.0	N.A.	2.3
Portugal	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	3.6	0.0	0.0	0.0	N.A.	0.9
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

Table 128. Killed drivers – Distribution of positive drivers – Illicit opiates only

Mutually exclusive group - Percentage of drivers positive for ILLICIT OPIATES ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

Table 129. Killed drivers – Distribution of positive drivers – Benzodiazepines only

Mutually exclusive group - Percentage of drivers positive for BENZODIAZEPINES ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	4.7	5.9	7.0	N.A.	4.6
Norway	0.0	0.0	0.0	2.7	N.A.	0.8
Portugal	0.0	1.5	0.0	1.2	0.0	0.8
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	6.3	0.0	9.7	9.7	N.A.	8.0
Norway	12.5	0.0	0.0	14.3	N.A.	5.7
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

Table 130. Killed drivers – Distribution of positive drivers – Z-drugs only

Mutually exclusive group - Percentage of drivers positive for Z-DRUGS ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	1.0	0.0	0.0	4.9	N.A.	2.2
Norway	0.0	0.0	3.8	0.0	N.A.	0.8
Portugal	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	0.0	0.0	4.8	4.4	N.A.	2.8
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	0.0	0.0	0.0	14.3	N.A.	2.9
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	10.0	0.0	N.A.	2.9

Table 131. Killed drivers – Distribution of positive drivers – Medicinal opioids only

Mutually exclusive group - Percentage of positive for MEDICINAL OPIOIDS ONLY						
MALE	Among subjects of the same age group					Among all male subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	1.0	0.0	1.5	3.5	N.A.	1.9
Norway	0.0	0.0	0.0	0.0	N.A.	0.0
Portugal	0.0	1.5	0.0	1.2	0.0	0.8
Sweden	0.0	0.0	0.0	2.2	N.A.	0.9
FEMALE	Among subjects of the same age group					Among all female subjects
	18-24	25-34	35-49	50 and over	Age unknown	
Finland	0.0	0.0	0.0	0.0	N.A.	0.0
Norway	12.5	0.0	0.0	0.0	N.A.	2.9
Portugal	0.0	0.0	0.0	0.0	N.A.	0.0
Sweden	0.0	0.0	0.0	0.0	N.A.	0.0

Part 2 – Country Reports from hospital studies

1 Country Report Belgium

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1.1 Description of the hospitalised driver sample

1.1.1 Introduction: description of main deviations and justifications/reasons

The Belgian national database includes injured drivers who were admitted in one of the following hospitals: Ghent University Hospital, Regional Hospital of Namur, University Hospital Sart Tilman (Liège), Leuven University Hospital and Brussels University Hospital. These 5 hospitals were selected because they participated in a previous similar study (Belgium Toxicology and Trauma Study) in 1995. The roadside study was adapted to the catchment areas of these hospitals. Samples were collected from patients hospitalised between January 2008 and May 2010.

Medical staff was in charge of filling in a patient form for each participant. One person among the staff members of the accident and emergency department was responsible for the study (see Annex 1 of the summary report). The patient form included the 'minimum required data' and optional data. (see annex 2)

The following optional information were not recorded:
- Nationality
- Driver license
- Clinical signs of impairment

As in Belgium no distinction is made between urban and rural road type, classification was made according to speed limit. Roads were grouped into two categories: 'other roads' (speed limit ≤ 90 km/h) and 'highway' (speed limit >90 km/h).

For type of vehicle 7 categories were included: personal car, van, truck/bus, motorcycle, bicycle, moped and other vehicles.

For the factor 'safety belt' the value 'not applicable', coded as a zero, was added in the database because of the inclusion of two-wheel vehicles.

1.1.2 Geographical distribution of hospitalised drivers over the country/region

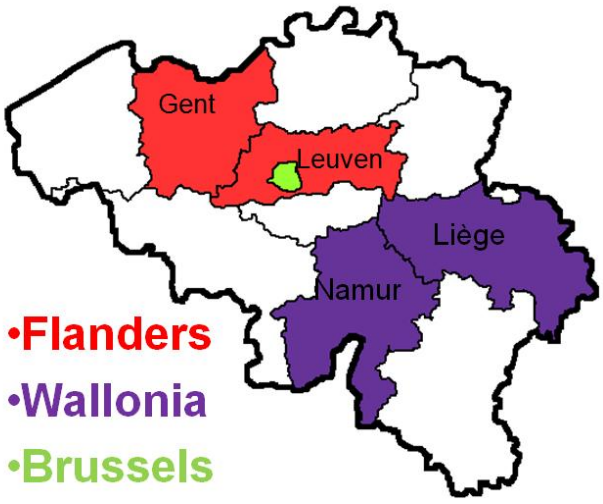


Figure 1. Geographical distribution of drivers over the country

For prevalence calculations, data were grouped under the three administrative Belgian regions (Brussels, Flanders and Wallonia), so that they could be compared with the data collected during the roadside survey.[18]

Overall, only 3.2% of our injured population was sampled in Brussels, while 81.3% were sampled in Flanders and 15.5% in Wallonia (Table 1). This sampling distribution is significantly different from the one obtained in Flanders and Wallonia during the roadside surveys. The roadside figures are comparable with the distribution of vehicle kilometres in these regions (see D 2.2.3).

Table 1. Distribution of drivers by region

	Distribution of injured drivers	Distribution of drivers in the roadside survey
Region		
Brussels	35 (3.2%)	3.7%
Flanders	876 (81.3%)	57.1%
Wallonia	167 (15.5%)	39.2%
Total	1078	2957

1.1.3 Distribution of drivers by hospital

A total of 1078 blood samples from injured drivers were collected and delivered to the laboratory with the corresponding patient form. Of the 1078 respondents, 40.8% were sampled in Ghent University Hospital, 40.4% in Leuven University Hospital, 3.2% in Brussels University Hospital, 15% in the Regional Hospital of Namur and only 0.5% in University Hospital Sart Tilman (Liège) (Table 2).

[18] Geographic distribution of roadside sessions was performed systematically. An equal number of sessions was scheduled in the catchment area of each hospital participating in DRUID task 2.2.b. For practical reasons, it was decided to include 9 police zones in each catchment area. These areas were defined based on information from the emergency services.

Table 2. Geographical distribution of drivers by hospital

Hospital	Distribution of injured drivers	
	n	%
Ghent	440	40.8%
Leuven	436	40.4%
Brussel	35	3.2%
Namur	162	15.0%
Sart Tilman (Liège)	5	0.5%
Total	1078	

1.1.4 Distribution of drivers by road type

Table 3. Distribution of drivers by road type

Road type	Distribution of injured drivers	
	n	%
Other roads (≤ 90 km/h)	797	73.9%
Highway (> 90 km/h)	118	10.9%
Unknown	163	15.1%
Total	1078	

The road type classification in this report differs from the one in the international description. 73.9% of the injured drivers were involved in an accident on 'other roads', while only 10.9% was involved in a 'highway' accident. For 163 injured drivers (15.1%) the site of the accident was unknown (Table 3).

1.1.5 Distribution of drivers by day of the week and time of the day

Table 4. Distribution of drivers by day of the week and time of the day

Time period	Distribution of injured drivers	
	n	%
1	160	14.8%
2	217	20.1%
3	186	17.3%
4	76	7.1%
5	60	5.6%
6	136	12.6%
7	138	12.8%
8	88	8.2%
Unknown	17	1.6%
Total	1078	

1 = Week 04:00-9:59
2 = Week 10:00-15:59
3 = Week 16:00-21:59
4 = Week 22:00-3:59
5 = Weekend 04:00-9:59
6 = Weekend 10:00-15:59
7 = Weekend 16:00-21:59
8 = Weekend 22:00-3:59

Most of the injured drivers were admitted during the week, between 10:00 and 15:59 (20.1%). Approximately half of the sample (52.2%) was involved in a weekday accident between 04:00 and 21:59 (time periods 1-3). The second biggest group (31%) was from weekend day accidents (time periods 5-7). Drivers injured during week nights (time period 4) accounted for 7.1% of the sample, while those injured during weekend nights (time period 8) accounted for 8.2%.

For the calculation of the results reported below, time periods were aggregated into day (time periods 1-3 and 5-7), night (time periods 4&8), week (time periods 1-4) and weekend (time periods 5-8).

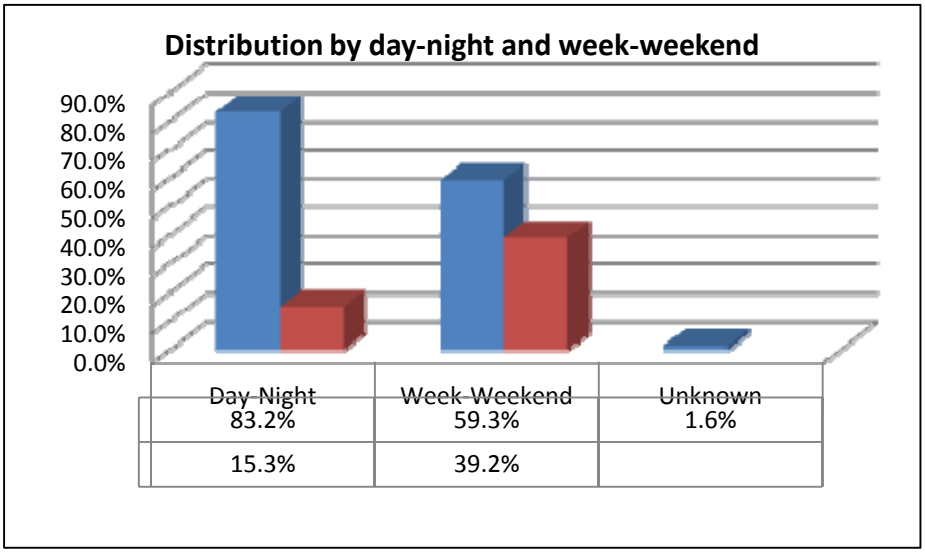


Figure 2. Distribution of drivers by day vs night and week vs weekend

1.1.6 Distribution of drivers by season

Table 5. Distribution of drivers by season

Quarter of the year	Distribution of injured drivers			Distribution of traffic accidents[19]	
	n	%	% weighted for sampling period	n	%
First	230	21.3%	17.2%	2207	19.4%
Second	265	24.6%	23.2%	2932	27.8%
Third	335	31.1%	34.5%	3188	28.0%
Fourth	245	22.7%	25.2%	3061	26.8%
Unknown	3	0.3%			
Total	1078			11388	

Taking into account the sampling period being from 24/1/2008 to 2/5/2010, no equal amount of quarters of the year was obtained. Adjusted percentage was calculated by weighing for the sampling period (see table 5)
Most accidents occurred in the third quarter of the year (34.5%). Distribution of drivers in the other seasons was quite similar, with 17.2% of respondents sampled in the first quarter of the year, 23.2% in the second and 25.2% in the fourth. However, when calculating the confidence intervals, a slight significant difference was found for the second and third of the year between the data collected in this study and the distribution of traffic accidents in 2006 [2].

[19] Studie van de uitwendige oorzaken in de minimale klinische gegevens (2010). Figures from 2006

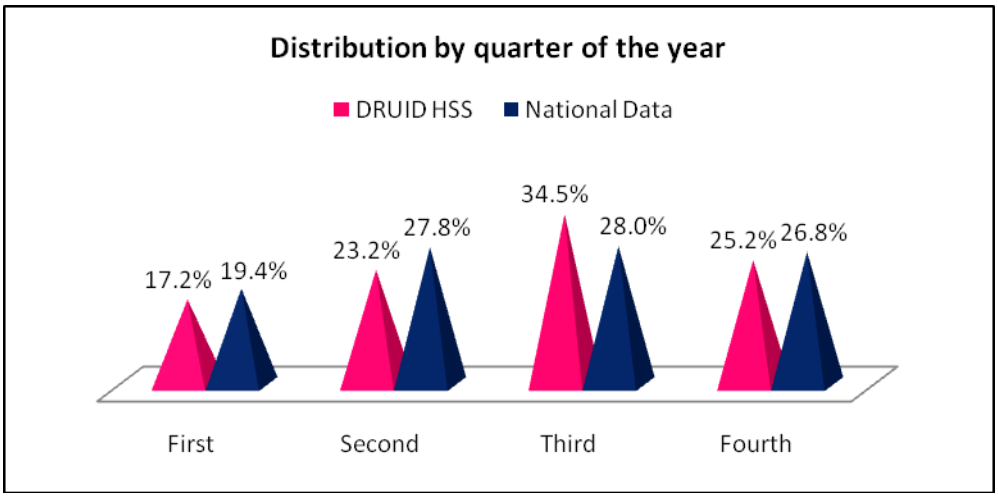


Figure 3. Distribution of injured drivers by quarter of the year (weighted DRUID percentage)

1.1.7 Distribution of drivers by injury severity

Table 6. Distribution of drivers by injury severity

Injury severity (MAIS)	Distribution of injured drivers	
	n	%
1	2	0.2%
2	734	68.1%
3	248	23.0%
4	41	3.8%
5	31	2.9%
Unknown	22	2.0%
Total	1078	

91.1% of the drivers had a MAIS score of 2 or 3 (68.1% and 23.0% respectively). 3.8% had a MAIS score of 4, and 2.9% had a MAIS score of 5. For 0.2% of the sample the MAIS score was rated as 1, while for 22 subjects (2%) the MAIS score was not recorded.

1.1.8 Distribution of drivers by age and gender

Table 7. Distribution of drivers by age and gender

Age groups		Gender						Total	
		male		female		unknown			
		n	%	n	%	n	%	n	%
	unknown	16	2.0%	4	1.5%	1	100.0%	21	1.9%
	17 years	4	0.5%	0	0%	0	0%	4	0.4%
	18-24	153	18.9%	50	18.7%	0	0%	203	18.8%
	25-34	175	21.6%	51	19.0%	0	0%	226	21.0%
	35-49	236	29.2%	71	26.5%	0	0%	307	28.5%
	50+	225	27.8%	92	34.3%	0	0%	317	29.4%
Total		809		268		1		1078	

75% (809) of injured drivers were male and 24.9% (268) female (Table 7). 49.5% of the sample belonged to the age groups 25-34 (21.0%) and 35-49 (28.5%). The group aged 50 and over included 317 subjects (29.4%).

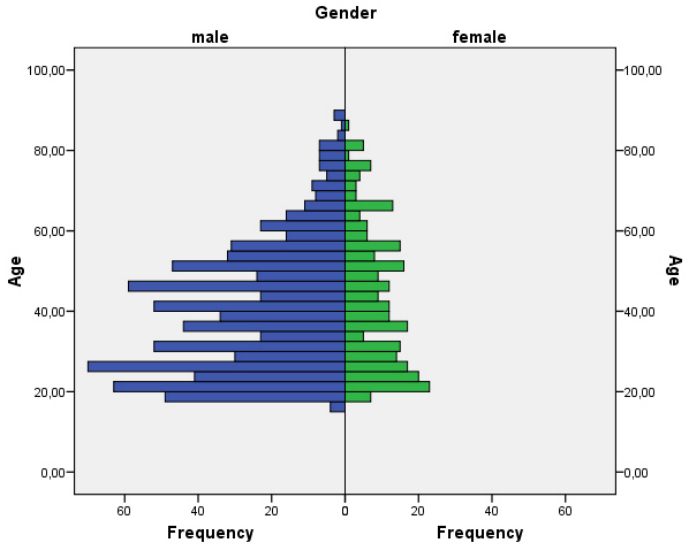


Figure 4. Age and gender distribution of injured drivers

1.1.9 Distribution of drivers by safety belt use

Table 8. Distribution of drivers by safety belt use

Safety belt use	Distribution of drivers	
	n	%
Yes	244	22.6%
No	100	9.3%
Not applicable	679	63.0%
Unknown	55	5.1%
Total	1078	

Data about safety belt use are shown in Table 8. It has to be noted that, at the time of the accident, 63.0% of the respondents were driving vehicles that were not fitted with a safety belt, such as motorcycles, bicycles or mopeds. If this is taken into consideration, out of 399 subjects involved in a road traffic accident while driving a vehicle fitted with safety belts (personal cars, vans, bus and trucks), 61.2% were using a seat belt while 25.1% were not. Use of safety belt was unknown in 13.8%.

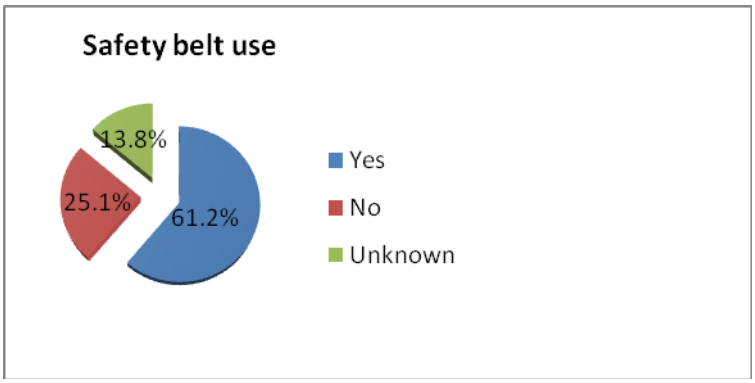


Figure 5. Safety belt use in vehicles fitted with safety belts

1.1.10 Distribution of drivers by type of vehicle

Table 9. Distribution of drivers by type of vehicle

Type of vehicle	Distribution of drivers	
	n	%
Personal car	353	32.7%
Van	24	2.2%
Motorcycle	159	14.7%
Moped	96	8.9%
Bicycle	413	38.3%
Bus/truck > 3500kg	22	2.0%
Other vehicles	11	1.0%
Total	1078	

Of the 1078 subjects included in the study, approximately 35% were driving either a personal car or a van at the time of the accident.

1.1.11 Distribution of drivers by accident type

Table 10. Distribution of drivers by accident type

Accident type	Distribution of drivers	
	n	%
Single-vehicle accident	500	46.4%
Multi-part accident	517	48.0%
Unknown	61	5.6%
Total	1078	

46.4% (500) of the sampled drivers had a single-vehicle accident, while 48% (517) was involved in a multi-part accident.
Multi-part accidents are defined as accidents involving more than one moving part in the traffic. The distribution of counterparts is given in Figure 6.

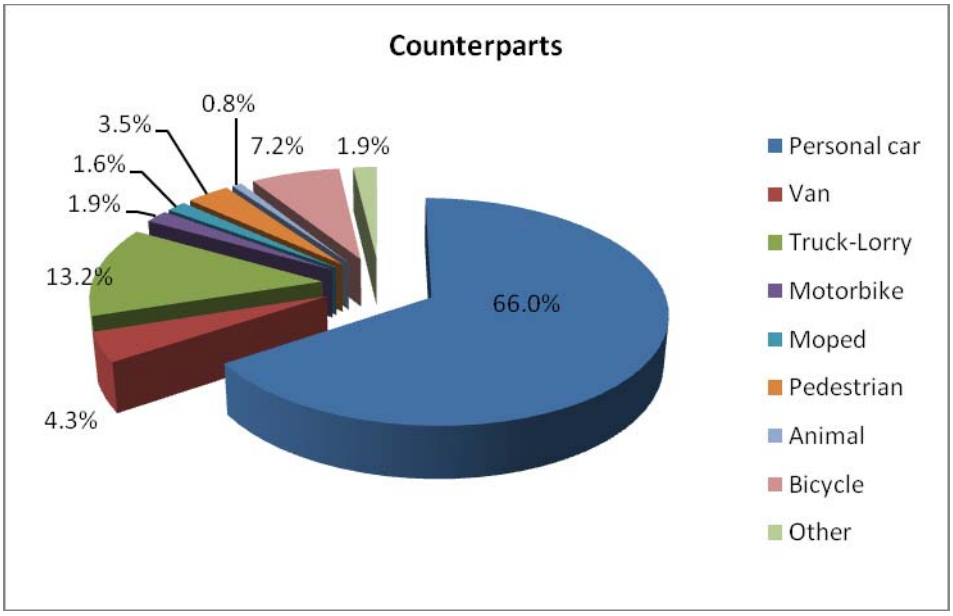


Figure 6. Distribution of counterparts in the multipart accident group (N=517)

If the accident type were divided into single-vehicle (involving only one vehicle) and multi-vehicle (involving two or more vehicles), 22 accidents, with either a pedestrian or an animal as the counterpart, would be classified as single-vehicle accidents and the distribution would change slightly as showed in Table 11. For the results described below, accidents have been grouped into single-vehicle and multi-vehicle.

Table 11. Distribution of drivers by single-vehicle and multi-vehicle type

Accident type	Distribution of drivers	
	n	%
Single-vehicle accident	522	48.4%
Multi-vehicle accident	495	45.9%
Unknown	61	5.7%
Total	1078	

1.2 Methods: data collection and analysis

1.2.1 Ethical approval

The protocol was submitted to the ethics committee of Ghent University Hospital. Approval was obtained on 19/11/2008. (Belgian registration number B67020072944)

1.2.2 Setup of the sampling (specimen collection, site of sampling)

The data collection took place in the emergency departments of the selected hospitals (see section 1.1.1). A flow chart on the data collection procedure and a thesaurus for the medical personnel were prepared.(see annex 1 and 2 of the Belgian report).
Blood samples were taken using a 5 mL glass collection tube containing potassium oxalate and sodium fluoride.

Samples were stored in freezers at the hospitals. Shipments (under cooled conditions) to the laboratory of the Department of Clinical chemistry, microbiology and immunology of Ghent University were done on regular basis.

1.2.3 Toxicological analysis of body fluids

Toxicological analyses were performed in the laboratory of the Department of Clinical chemistry, microbiology and immunology of Ghent University.
The following methods were used for the toxicological analysis of the whole blood samples:

- enzymatic method for ethanol analysis
- solid phase extraction followed by UPLC-MS/MS analysis for all substances except cannabinoids
- ELISA screening (qualitative) for cannabinoids
- liquid-liquid extraction followed by GC-MS analysis for samples that gave positive result at the ELISA screening for cannabinoids.

Detailed information on the toxicological analyses can be found in annex 1
A list of applied DRUID cut-offs can be found in the summary report.

1.2.4 Method of BAC quantification

Blood alcohol concentration, in g/L, was determined in whole blood samples using an enzymatic method (alcohol dehydrogenase).

1.2.5 Other collected data

Hospital staff was asked to record the following information on the patient datasheet:

Patient information

- Identification number (for labelling of samples and recorded data)
- Age and gender
- Time and date of sampling
- Medication/Fluids administered prior to blood sampling
- Severity of injuries (according to MAIS trauma scales)

Accident information

- Time and date of the accident
- Time of ambulance arrival
- Place of accident for road type classification (highway or other roads)
- Type of vehicle of the injured driver (passenger car, van, truck/lorry, motorcycle, moped, bicycle, unknown, others: e.g. quad)
- Type of other vehicle/part involved in the accident (personal car, van, truck/lorry, motorcycle, moped, pedestrian, animal, bicycle, fixed object: e.g. wall, unknown and other)
- Condition of the road (dry, wet, dirty, snow, ice, unknown, other)
- Use of safety belt (yes, no, not applicable, unknown)
- Weather conditions (dry, rain, fog, snow, hail, unknown, other)
- Maximum speed (<30, 40-50, 60-90, >100 km/h, unknown)
- Highest education degree of the patient (primary school, low secondary school, high secondary school, university college type (2-3 years), college-long type (4years), university)
- Outcome for the patient (discharge, hospitalised, deceased)

1.2.6 Statistical analysis

In order to calculate frequencies to describe the distribution of drivers (by age groups, gender, road type, etc.) statistical analysis were carried out using the software package

SPSS, version 15 (renamed in PASW). Confidence intervals (95%) for difference in proportions were calculated to determine the significance of the differences.

1.3 Non- response and missing cases

105 additional respondents had to be excluded from the database as no blood sample was available for toxicological analysis.
For 67 people a patient form was filled in, but they refused to give a blood sample for toxicological analysis. The figures below (non-response) are based on these 67 subjects. For some other subjects, who refused to take part in the study, no form may have been filled in. Since correct non-response data is only available for the hospitals in Ghent and Leuven, statistical analysis was carried out only for those hospitals. Because of the low number of non-respondent forms any comparison should be made cautiously. Also, the size of non-response may have been underestimated to some extent based on the fact of the low number of samples in 2 hospitals (Brussels and Liège).

1.3.1 Size and nature of non-response

Following tables were calculated on refusals (n= 65) and respondents (=876) in the hospitals of Ghent and Leuven.

1.3.1.1 Age and Gender

Table 12. Non-response distribution by gender

Gender	Refusals		Respondents		Total	
	n	%	n	%	n	%
Male	38	63.3%	646	73.7%	684	73.1%
Female	22	36.7%	230	26.3%	252	26.9%
Total	60		876		936	

Note: 5 refusers had unknown gender and were left out this calculation

73.7% (684) of the respondents were male and 26.3% (230) female. 63.3% of the drivers who refused to participate in the research were male and 36.7% female. No statistically significant difference was found between both response groups (p= 0.079).

Table 13. Non-response distribution by age

Age groups	Refusals		Respondents		Total	
	n	%	n	%	n	%
18-24	18	28.1%	167	19.1%	185	19.7%
25-34	12	18.8%	187	21.4%	199	21.2%
35-49	17	26.6%	242	27.7%	259	27.6%
50 or older	17	26.6%	279	31.9%	296	31.5%
Total	64		875		939	

Note: 1 refusal and 1 respondent had unknown age and were left out this calculation

53.2% of the drivers who refused to participate in the DRUID-research belonged to the two age groups 35-49 and 50 or older. 59.6% of the drivers who took part in the study could be placed in the age group 35-49 (27.7%) and the age group 50 or older (31.9%). No significant statistical difference was found between both response groups (p= 0.358).

1.3.1.2 Type of vehicle

Since the frequencies of some vehicle types were too low, non response calculations were only made on the three most frequently used types of vehicle (n>5 in refusals): personal car, motorbike and bicycle.

Table 14. Non-response distribution by type of vehicle (personal car, motorbike and bicycle)

Type of vehicle	Refusals		Respondents		Total	
	n	%	n	%	n	%
Personal car	21	37.5%	247	32.8%	268	33.1%
Motorbike	7	12.5%	120	15.9%	127	15.7%
Bicycle	28	50%	386	51.3%	414	51.2%
Total	56		753		809	

Note: Following numbers were excluded: for refusals: 3 unknown, 1 van, 3 mopeds, 2 other; for respondents: 21 vans, 79 mopeds, 19 bus/trucks, 4 other

51.3% of the respondents rode a bicycle, 50% of the refusals were cyclists. No significant statistical difference was found between both response groups (p= 0.685).

1.3.1.3 Distribution of drivers by time period

Table 15. Non-response distribution by time period

Time periods	Refusals		Participants		Total	
	n	%	n	%	n	%
1:Monday to Friday, 04:00 to 09:59	9	15.0%	123	14.1%	132	14.1%
2:Monday to Friday, 10:00 to 15:59	10	16.7%	188	21.5%	198	21.2%
3:Monday to Thursday, 16:00 to 21:59	16	26.7%	155	17.7%	171	18.3%
4:Monday to Thursday, 22:00 to 03:59	5	8.3%	63	7.2%	68	7.3%
5: Saturday and Sunday, 04:00 to 09:59	6	10.0%	45	5.1%	51	5.5%
6:Saturday and Sunday, 10:00 to 15:59	2	3.3%	116	13.3%	118	12.6%
7:Friday to Sunday, 16:00 to 21:59	8	13.3%	114	13.0%	122	13.0%
8:Friday to Sunday, 22:00 to 03:59	4	6.7%	71	8.1%	75	8.0%
Total	60		875		935	

Note: 5 refusals and 1 participant had unknown time category and were left out this calculation.

Most of the refusals and of the participants were sampled on weekdays between 10:00-21:59 (refusal: 43.4%; participant: 39.2%) and weekend days in the time frame 16:00-21:59 (refusal: 13.3%; participant: 13.0%).
When leaving out time period 6 and 8, because of the lower number of refusals (n<5), no significant statistical difference was found (p= 0.52). By calculating confidence intervals for the difference in proportions, a significant difference was found for time period 6. Time period 8 was equally distributed between both response groups.

1.3.2 Effects of non-response

It is unlikely that the non-response had a significant effect on the distribution of results of the present study, even if its size may have been underestimated to some extent for the reasons reported above.

1.4 Results

1.4.1 Substance group distribution + substance classes (alcohol, illicit and medicinal drugs)

1.4.1.1 General distribution of substance classes and groups

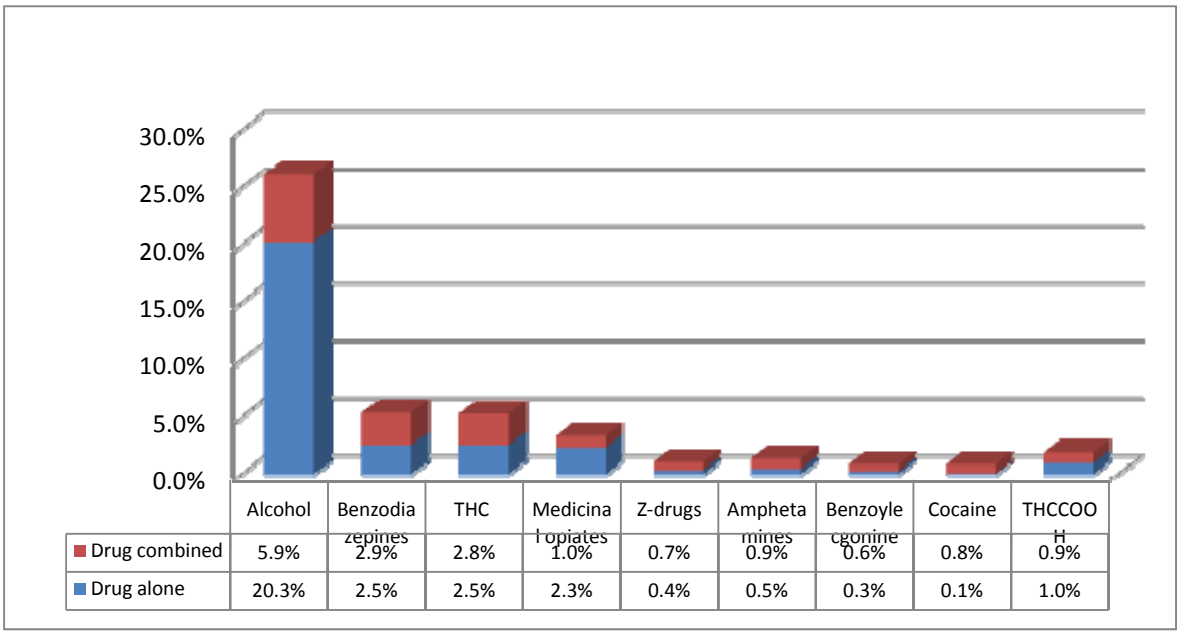
Table 16. Distribution of substance classes (mutually exclusive groups)

Substance class	Number of cases	Percentage
None	679	63.0
Alcohol only	219	20.3
Illicit drugs only	53	4.9
Medicinal drugs only	59	5.5
Alcohol + illicit drugs	30	2.8
Alcohol + medicinal drugs	27	2.5
Illicit + medicinal drugs	4	0.4
Alcohol + illicit + medicinal drugs	7	0.6
Total	1078	100.0

Table 17. Distribution of substance groups

Type	Group	Number of cases	Percentage
None		679	63.0
Alcohol	Alcohol	219	20.3
Illicit Drugs	Amphetamines	5	0.5
	Benzoylecgonine only	3	0.3
	Cocaine (+ benzoylecgonine)	1	0.1
	THCCOOH only	11	1.0
	THC (+THCCOOH)	27	2.5
	Illicit opiates	0	0
Medicinal drugs	Benzodiazepines	27	2.5
	Z-drugs	4	0.4
	Opiates and opioids	25	2.3
Various combinations	Drug-alcohol	64	5.9
	Drug-drug	13	1.2
Total		1078	

37% of drivers were found positive for one or more (il)licit substances. The highest prevalence was found for alcohol only (20.3%). 5.5% of the sampled subjects were positive for medicinal drugs only: benzodiazepines (2.5%) and medicinal opioids (2.3%) being the most common drugs detected. 4.9% of patients had used an illicit drug only with the highest prevalence for THC (2.5%). The most common combinations found were benzodiazepines + alcohol (1.9%) and THC + alcohol (1.5%).



	Alcohol	Benzodiazepines	THC	Medicinal opiates	Z-drugs	Amphetamines	Benzoylecgonine	Cocaine	THCCOOH
Drug combined	5.9%	2.9%	2.8%	1.0%	0.7%	0.9%	0.6%	0.8%	0.9%
Drug alone	20.3%	2.5%	2.5%	2.3%	0.4%	0.5%	0.3%	0.1%	1.0%

Figure 7. Distribution of drugs alone and combined

In figure 7 the total distribution of all substance groups are shown, taking into account both the drug alone or in combination. In 26.2% of the samples alcohol was found, cannabis in 7.2%. The other groups have a higher prevalence for the combinations compared to the prevalence of the substance alone, except for medicinal opioids. A reason for this might be that administration of drugs prior to blood sampling may have not been recorded on the patient form.

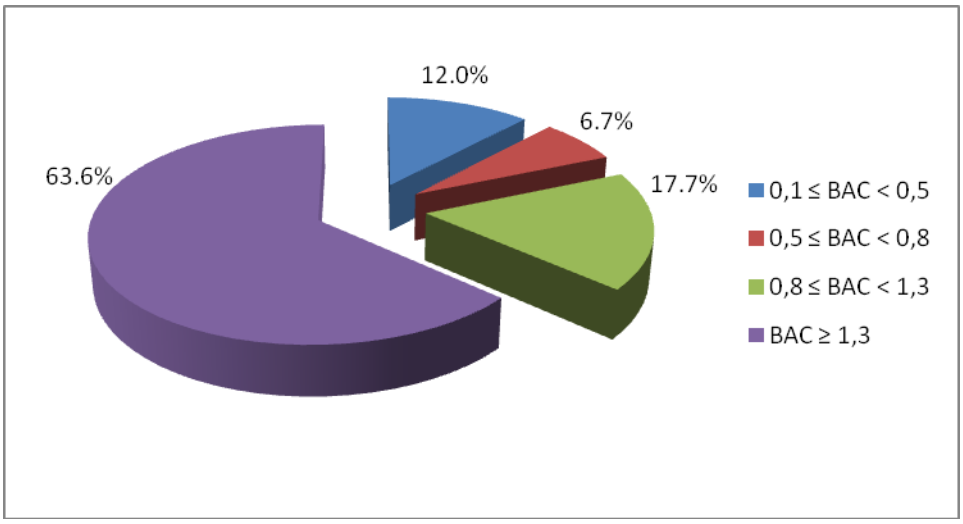


Figure 8. Distribution of positive alcohol findings by BAC-group (in g/l)

In general 26.2% of the injured drivers was found positive for alcohol. Of these 283 subjects, 12% had a BAC between 0.1 g/l (= DRUID cut-off) and 0.5 g/l (=the legal cut-off in Belgium) and 63.6% had a BAC at or above 1.3 g/l.

1.4.1.2 Detailed substance group distribution by region

Table 18. Distribution of substance groups by region

Type	Group	Brussels		Flanders		Wallonia	
		n	%	n	%	n	%
None		24	68.6%	581	66.3%	74	44.3%
Alcohol	Alcohol	6	17.1%	165	18.8%	48	28.7%
Illicit Drugs	Amphetamines	0	0%	5	0.6%	0	0%
	Benzoylecgonine only	1	2.9%	2	0.2%	0	0%
	Cocaine (+BE)	0	0%	1	0.1%	0	0%
	THCCOOH only	0	0%	9	1.0%	2	1.2%
	THC (+THCCOOH)	2	5.7%	19	2.2%	6	3.6%
	Illicit opiates	0	0%	0	0%	0	0%
Medicinal drugs	Benzodiazepines	0	0%	22	2.5%	5	3.0%
	Z-drugs	0	0%	3	0.3%	1	0.6%
	Opiates and opioids	0	0%	20	2.3%	5	3.0%
Various combinations	Drug-alcohol	2	5.7%	41	4.4%	21	12.6%
	Drug-drug	0	0%	8	0.8%	5	3.0%
Total		35		876		167	

Taking into account the lower sampling in Brussels and Wallonia, the prevalence of positive drivers was found equal in Brussels and Flanders, but higher in Wallonia. In Brussels 31.4% of the sampled drivers were positive for one or more substances, in Flanders 33.7% and in Wallonia 55.7%.

Table 19. Detailed substance group distribution by regions: Brussels, Flanders and Wallonia

Substances	Region			Total
	Brussels	Flanders	Wallonia	
None	24(68.6%)	581(66.3%)	74 (44.3%)	679 (63.0%)
Amphetamines only	0	5 (0.6%)	0	5 (0.5%)
Benzoylecgonine only	1 (2.9%)	2 (0.2%)	0	3 (0.3%)
Cocaine only	0	1 (0.1%)	0	1 (0.1%)
THCCOOH only	0	9 (1.0%)	2 (1.2%)	11 (1.0%)
THC only	2 (5.7%)	19 (2.2%)	6 (3.6%)	27 (2.5%)
Amphetamine + THC	0	1 (0.1%)	1 (0.6%)	2 (0.2%)
Benzoylecgonine +THC	0	1 (0.1%)	1 (0.6%)	2 (0.2%)
Amphetamine + benzoylecgonine + THC	0	1 (0.1%)	0	1 (0.1%)
Amphetamine + cocaine + THC	0	1 (0.1%)	0	1 (0.1%)
Benzodiazepines	0	22 (2.5%)	5 (3.0%)	27 (2.5%)
Amphetamine + THC + Benzodiazepine	0	1 (0.1%)	0	1 (0.1%)
Z-drugs	0	3 (0.3%)	1 (0.6%)	4 (0.4%)
Benzodiazepines +Z-drugs	0	0	1 (0.6%)	1 (0.1%)
Medicinal opioids	0	20 (2.3%)	5 (3.0%)	25 (2.3%)
Benzoylecgonine + medicinal opioids	0	0	1 (0.6%)	1 (0.1%)
THC + medicinal opioids	0	1 (0.1%)	1 (0.6%)	2 (0.2%)
Benzodiazepines + medicinal opioids	0	1 (0.1%)	0	1 (0.1%)
Z-drugs + medicinal opioids	0	1 (0.1%)	0	1 (0.1%)
Alcohol only	6 (17.1%)	165 (18.8%)	48 (28.7%)	219 (20.3%)
Amphetamines + alcohol	0	1 (0.1%)	0	1 (0.1%)
Benzoylecgonine + alcohol	0	0	1 (0.6%)	1 (0.1%)
Cocaine + alcohol	0	1 (0.1%)	1 (0.6%)	2 (0.2%)
Amphetamines + cocaine + alcohol	0	1 (0.1%)	0	1 (0.1%)
THCCOOH + alcohol	0	4 (0.5%)	1	5 (0.2%)
Benzoylecgonine + THCCOOH + alcohol	0	1 (0.1%)	0	1 (0.1%)
Cocaine + THCCOOH + alcohol	0	0	1 (0.6%)	1 (0.1%)
THC + alcohol	2 (5.7%)	11 (1.3%)	3 (1.8%)	16(1.5%)
Cocaine + THC + alcohol	0	2 (0.2%)	0	2 (0.2%)
Benzodiazepines + alcohol	0	10 (1.1%)	10 (6.0%)	20 (1.9%)
Cocaine + Benzodiazepines + alcohol	0	1 (0.1%)	0	1 (0.1%)
THC + benzo + alcohol	0	1 (0.1%)	1 (0.6%)	2 (0.2%)
Amphetamines + THC + benzo + alcohol	0	1 (0.1%)	0	1 (0.1%)
Z-drug + alcohol	0	2 (0.2%)	0	2 (0.2%)
Benzo + z-drug + alcohol	0	1 (0.1%)	2 (1.2%)	3 (0.3%)
Medicinal opioids + alcohol	0	1 (0.1%)	1 (0.6%)	2 (0.2%)
Amphetamines + medicinal opioids + alcohol	0	1 (0.1%)	0	1 (0.1%)
THCCOOH + medicinal opioids + alcohol	0	2 (0.2%)	0	2 (0.2%)
Total	35 (100.0%)	876 (99.5%)	167 (100.0%)	1078 (100%)

The higher percentage for benzoylecgonine in Brussels does not result in a higher prevalence for that region, because of the low number of sampling in Brussels compared to Flanders, there is no significant difference between the two proportions.

1.4.2 Distribution of substance groups by DRUID time periods aggregated into day vs. night, week vs. WE

For this distribution, time period remained unknown in 17 cases (1.7%).

Table 20. Distribution of substance groups by Day vs Night

Type	Group	Day		Night		Unknown	
		n	%	n	%	n	%
None		615	68.5%	57	34.8%	7	41.2%
Alcohol	Alcohol	127	14.2%	86	52.4%	6	35.3%
Illicit Drugs	Amphetamines	4	0.4%	1	0.6%	0	0%
	Benzoylecgonine only	3	0.3%	0	0%	0	0%
	Cocaine (+BE)	1	0.1%	0	0%	0	0%
	THCCOOH only	11	1.2%	0	0%	0	0%
	THC (+THCCOOH)	26	2.9%	1	0.6%	0	0%
	Illicit opiates	0	0%	0	0%	0	0%
Medicinal drugs	Benzodiazepines	25	2.8%	0	0%	2	11.8%
	Z-drugs	1	0.1%	2	1.2%	1	5.9%
	Opiates & opioids	24	2.7%	1	0.6%	0	0%
Various combinations	Drug-alcohol	49	5.5%	14	8.5%	1	5.9%
	Drug-drug	11	1.2%	2	1.2%	0	0%
Total		897		164		17	

Toxicological results showed a higher prevalence of positive drivers in the night-time group mainly due to alcohol. Cannabis and medicinal opioids were found more during daytime, while alcohol alone was more prevalent during nights. Benzodiazepines were only found during daytime. In general different drug-alcohol and drug-drug combinations were equal during day and night.

Table 21. Detailed substance groups distribution by Day vs Night

Substances		Day	Night
	None	615 (68.6%)	57 (34.8%)
	Amphetamines only	4 (0.4%)	1 (0.6%)
	Benzoylecgonine only	3 (0.3%)	0
	Cocaine only	1 (0.1%)	0
	THCCOOH only	11 (1.2%)	0
	THC only	26 (2.9%)	1 (0.6%)
	Amphetamine + THC	2 (0.2%)	0
	Benzoylecgonine +THC	1 (0.1%)	1 (0.6%)
	Amphetamine + benzoylecgonine + THC	1 (0.1%)	0
	Amphetamine + cocaine + THC	1 (0.1%)	0
	Benzodiazepines	25 (2.8%)	0
	Amphetamine + THC + Benzodiazepine	0	1 (0.6%)
	Z-drugs	1 (0.1%)	2 (1.2%)
	Benzodiazepines +Z-drugs	1 (0.1%)	0
	Medicinal opioids	24 (2.7%)	1 (0.6%)
	Benzoylecgonine + medicinal opioids	1 (0.1%)	0
	THC + medicinal opioids	2 (0.2%)	0
	Benzodiazepines + medicinal opioids	1 (0.1%)	0
	Z-drugs + medicinal opioids	1 (0.1%)	0
	Alcohol only	127 (14.2%)	86 (52.4%)
	Amphetamines + alcohol	0	1 (0.6%)
	Benzoylecgonine + alcohol	1 (0.1%)	0
	Cocaine + alcohol	1 (0.1%)	1 (0.6%)
	Amphetamines + cocaine + alcohol	1 (0.1%)	0
	THCCOOH + alcohol	5 (0.6%)	0
	Benzoylecgonine + THCCOOH + alcohol	1 (0.1%)	0
	Cocaine + THCCOOH + alcohol	1 (0.1%)	0
	THC + alcohol	9 (1.0%)	7 (4.3%)
	Cocaine + THC + alcohol	2 (0.2%)	0
	Benzodiazepines + alcohol	16 (1.8%)	4 (2.4%)
	Cocaine + Benzodiazepines + alcohol	1 (0.1%)	0
	THC + benzo + alcohol	1 (0.1%)	0
	Amphetamines + THC + benzo + alcohol	1 (0.1%)	0
	Z-drug + alcohol	2 (0.2%)	0
	Benzo + z-drug + alcohol	3 (0.3%)	0
	Medicinal opioids + alcohol	1 (0.1%)	1 (0.6%)
	Amphetamines + medicinal opioids + alcohol	1 (0.1%)	0
	THCCOOH + medicinal opioids + alcohol	2 (0.2%)	0
Total		897 (99.5%)	164 (99.9%)

A deeper insight into the different drug-alcohol combinations shows that the association THC + alcohol was more prevalent during night, while the combination benzodiazepines + alcohol had a similar distribution during day and night.

Table 22. Distribution of substance groups by week vs. weekend

Type	Group	Week		Weekend		Unknown	
		n	%	n	%	n	%
None		442	69.2%	230	54.2%	7	41.2%
Alcohol	Alcohol	95	14.8%	118	28.0%	6	35.3%
Illicit Drugs	Amphetamines	4	0.6%	1	0.2%	0	0%
	Benzoylecgonine only	2	0.3%	1	0.2%	0	0%
	Cocaine (+BE)	0	0%	1	0.2%	0	0%
	THCCOOH only	6	0.9%	5	1.2%	0	0%
	THC (+THCCOOH)	23	3.6%	4	0.9%	0	0%
	Illicit opiates	0	0%	0	0%	0	0%
Medicinal drugs	Benzodiazepines	17	2.7%	8	1.9%	2	11.8%
	Z-drugs	3	0.5%	0	0%	1	5.9%
	Opiates and opioids	14	2.2%	11	2.6%	0	0%
Various combinations	Drug-alcohol	26	4.1%	37	8.8%	1	5.9%
	Drug-drug	7	1.1%	6	1.4%	0	0%
Total		639		422		17	

Apart from benzodiazepines, medicinal opioids and drug-drug combinations, which were equally distributed, the prevalence of other substances was significantly different between week and weekend. In general more positive drivers were found during weekends. Alcohol alone and combinations drug-alcohol were both more prevalent during weekend, with an increase of approximately twofold. Cannabis was present especially during weeks.

Table 23. Detailed substance group distribution by week vs weekend

Substances		week	weekend
	None	441 (69.0%)	229 (54.3%)
	Amphetamines only	4 (0.6%)	1 (0.2%)
	Benzoylecgonine only	2 (0.3%)	1 (0.2%)
	Cocaine only	0	1 (0.2%)
	THCCOOH only	6 (0.9%)	5 (1.2%)
	THC only	23 (3.6%)	4 (0.9%)
	Amphetamine + THC	1 (0.2%)	1 (0.2%)
	Benzoylecgonine +THC	1 (0.2%)	1 (0.2%)
	Amphetamine + benzoylecgonine + THC	0	1 (0.2%)
	Amphetamine + cocaine + THC	1 (0.2%)	0
	Benzodiazepines	17 (2.6%)	8 (1.9%)
	Amphetamine + THC + Benzodiazepine	0	1 (0.2%)
	Z-drugs	3 (0.5%)	0
	Benzodiazepines +Z-drugs	1 (0.2%)	0
	Medicinal opioids	14 (2.2%)	11 (2.6%)
	Benzoylecgonine + medicinal opioids	0	1 (0.2%)
	THC + medicinal opioids	2 (0.3%)	0
	Benzodiazepines + medicinal opioids	1 (0.2%)	0
	Z-drugs + medicinal opioids	0	1 (0.2%)
	Alcohol only	95 (14.9%)	118 (28.0%)
	Amphetamines + alcohol	1 (0.2%)	0
	Benzoylecgonine + alcohol	0	1 (0.2%)
	Cocaine + alcohol	1 (0.2%)	1 (0.2%)
	Amphetamines + cocaine + alcohol	0	1 (0.2%)
	THCCOOH + alcohol	1 (0.2%)	4 (0.9%)
	Benzoylecgonine + THCCOOH + alcohol	0	1 (0.2%)
	Cocaine + THCCOOH + alcohol	1 (0.2%)	0
	THC + alcohol	5 (0.8%)	11 (2.6%)
	Cocaine + THC + alcohol	0	2 (0.5%)
	Benzodiazepines + alcohol	11 (1.7%)	9 (2.1%)
	Cocaine + Benzodiazepines + alcohol	1 (0.2%)	0
	THC + benzo + alcohol	1 (0.2%)	0
	Amphetamines + THC + benzo + alcohol	1 (0.2%)	0
	Z-drug + alcohol	1 (0.2%)	1 (0.2%)
	Benzo + z-drug + alcohol	1 (0.2%)	2 (0.5%)
	Medicinal opioids + alcohol	0	2 (0.5%)
	Amphetamines + medicinal opioids + alcohol	1 (0.2%)	0
	THCCOOH + medicinal opioids + alcohol	0	2 (0.5%)
Total		639 (100.5%)	422 (99.5%)

For the combination alcohol + cannabis a significant difference between week and weekend was found, with a higher prevalence at weekends. The combination benzodiazepine and alcohol was not significantly different during the 7 days of the week.

1.4.3 Distribution of substance groups by gender and age

Table 24. Distribution of substance groups age and gender

Gender	Substances	Age groups						Total
		unknown	17y	18-24	25-34	35-49	50+	
Un-known	None	1 (100%)						1 (100%)
Total		1 (100%)						1 (100%)
Male	None	8 (44.4%)	2 (100%)	71 (46.4%)	90 (51.4%)	145 (61.4%)	166 (73.8%)	482 (59.6%)
	Alcohol	2 (11.1%)	0	44 (28.8%)	48 (27.4%)	60 (25.4%)	34 (15.1%)	188 (23.2%)
	Amphetamines	0	0	0	1 (0.6%)	1 (0.4%)	2 (0.9%)	4 (0.5%)
	Benzoylecgonine only	0	0	2 (1.3%)	0	1 (0.4%)	0	3 (0.4%)
	Cocaine (+BE)	0	0	0	1 (0.6%)	0	0	1 (0.1%)
	THCCOOH only	0	0	2 (1.3%)	5 (2.9%)	2 (0.8%)	1 (0.4%)	10(1.2%)
	THC (+THCCOOH)	1 (5.6%)	0	13 (8.5%)	5 (2.9%)	4 (1.7%)	0	23 (2.1%)
	Benzodiazepine	0	0	1 (0.7%)	0	7 (3.0%)	9 (4.0%)	17 (2.1%)
	Medicinal opioids	2 (11.1%)	0	3 (2.0%)	3 (1.7%)	4 (1.7%)	4 (1.8%)	16 (2.0%)
	Drug-alcohol	5 (27.8%)	0	16 (10.5%)	16 (9.1%)	10 (4.2%)	8 (3.6%)	55 (6.8%)
	Drug-drug	0	0	1 (0.7%)	6 (3.4%)	2 (0.8%)	1 (0.4%)	10(1.2%)
Total		18 (100%)	2 (100%)	153 (100%)	175 (100%)	236 (99.8%)	225 (99.9%)	809 (99.8%)
Female	None	1 (25.0%)		37 (74.0%)	39 (76.5%)	51 (71.8%)	68 (73.9%)	196 (73.1%)
	Alcohol	1 (25.0%)		5 (10.0%)	8 (15.7%)	10 (14.1%)	7 (7.6%)	31 (11.6%)
	Amphetamines	0		1 (2.0%)	0	0	0	1 (0.4%)
	THCCOOH only	0		1 (2.0%)				1 (0.4%)
	THC (+THCCOOH)	0		4 (8.0%)	0	0	0	4(1.5%)
	Benzodiazepines	0		0	0	2 (2.8%)	8 (8.7%)	10 (3.7%)
	Z-drugs	1 (25.0%)		0	0	2 (2.8%)	1 (1.1%)	4 (1.5%)
	Medicinal opioids	0		1 (2.0%)	1 (2.0%)	2 (2.8%)	5 (5.4%)	9 (3.4%)
	Drug-alcohol	1 (25.0%)		1 (2.0%)	2 (3.9%)	4 (5.6%)	1 (1.1%)	9 (3.4%)
	Drug-drug	0		0	1 (2.0%)	0	2 (2.2%)	3 (1.1%)
Total		4 (100%)		50 (100%)	51 (100%)	71 (100%)	92 (100%)	268 (100%)

Table 25. Detailed substance group distribution by age and gender

Gender	Substances	Age groups						
		unknown	18-24	25-34	35-49	50+	17y	Total
Male								
None		8 (44.0%)	71(46.4%)	90 (51.4%)	145 (61.4%)	166 (73.8%)	2 (100.0%)	482 (59.6%)
Amphetamines only		0	0	1 (0.6%)	1 (0.4%)	2 (0.9%)	0	4 (0.5%)
Benzoylecgonine only		0	2 (1.3%)	0	1 (0.4%)	0	0	3 (0.4%)
Cocaine only		0	0	1 (0.6%)	0	0	0	1 (0.1%)
THCCOOH only		0	2 (1.3%)	5 (2.9%)	2 (0.8%)	1 (0.4%)	0	10 (1.2%)
THC only		1 (5.6%)	13 (8.5%)	9 (2.9%)	4 (1.7%)	0	0	23 (2.8%)
Amphetamine + THC		0	1 (0.7%)	1 (0.6%)	0	0	0	2 (0.2%)
Benzoylecgonine +THC		0	0	0	1 (0.4%)	0	0	1 (0.1%)
Amphetamine + benzoylecgonine + THC		0	0	1 (0.6%)	0	0	0	1 (0.1%)
Amphetamine + cocaine + THC		0	0	1 (0.6%)	0	0	0	1 (0.1%)
Benzodiazepines		0	1 (0.7%)	0	7 (3.0%)	9 (4.0%)	0	17 (2.1%)
Amphetamine + THC + Benzodiazepine		0	0	1 (0.6%)	0	0	0	1 (0.1%)
Benzodiazepines +Z-drugs		0	0	0	1 (0.4%)	0	0	1 (0.1%)
Medicinal opioids		2 (11.1%)	3 (2.0%)	3 (1.7%)	4 (1.7%)	4 (1.8%)	0	16 (2.0%)
Benzoylecgonine + medicinal opioids		0	0	0	0	1 (0.4%)	0	1 (0.1%)
THC + medicinal opioids		0	0	2 (1.1%)	0	0	0	2 (0.2%)
Alcohol only		2 (11.1%)	44 (28.8%)	48 (27.4%)	60 (25.4%)	34 (15.1%)	0	188 (23.2%)
Amphetamines + alcohol		0	1 (0.7%)	0	0	0	0	1 (0.1%)
Benzoylecgonine + alcohol		0	1 (0.7%)	0	0	0	0	1 (0.1%)
Cocaine + alcohol		1 (5.6%)	0	1 (0.6%)	0	0	0	2 (0.2%)
Amphetamines + cocaine + alcohol		0	0	1 (0.6%)	0	0	0	1 (0.1%)
THCCOOH + alcohol		0	2 (1.3%)	2 (1.1%)	0	1 (0.4%)	0	5 (0.6%)
Benzoylecgonine + THCCOOH + alcohol			0	0	1 (0.4%)	0	0	1 (0.1%)
Cocaine + THCCOOH + alcohol			0	1 (0.6%)	0	0	0	1 (0.1%)
THC + alcohol		0	8 (5.2%)	8 (4.6%)	0	0	0	16 (2.0%)
Cocaine + THC + alcohol		0	1 (0.7%)	1 (0.6%)	0	0	0	2 (0.2%)
Benzodiazepines + alcohol		2 (11.1%)	1 (0.7%)	0	7 (3.0%)	5 (2.2%)	0	15 (1.9%)
Cocaine + Benzodiazepines + alcohol		0	0	0	1 (0.4%)	0	0	1 (0.1%)
THC + benzo + alcohol		1 (5.6%)	0	1 (0.6%)	0	0	0	2 (0.2%)
Amphetamines + THC + benzo + alcohol		0	0	0	1 (0.4%)	0	0	1 (0.1%)
Z-drug + alcohol		0	0	0	0	1 (0.4%)	0	1 (0.1%)
Benzo + z-drug + alcohol		1 (5.6%)	0	0	0	0	0	1 (0.1%)
Medicinal opioids + alcohol		0	1 (0.7%)	0	0	1 (0.4%)	0	2 (0.2%)
THCCOOH + medicinal opioids + alcohol		0	1 (0.7%)	1 (0.6%)	0	0	0	2 (0.2%)
Total		18	153	175	236	225	2	809
Female								

None	1 (25.0%)	37 (74.0%)	39 (76.5%)	51 (71.8%)	68 (73.9%)		196 (73.1%)
Amphetamines only	0	1 (2.0%)	0	0	0		1 (0.4%)
THCCOOH only	0	1 (2.0%)	0	0	0		1 (0.4%)
THC only	0	4 (8.0%)	0	0	0		4 (1.5%)
Benzoylecgonine +THC	0	0	1 (2.0%)	0	0		1 (0.4%)
Benzodiazepines	0	0	0	2 (2.8%)	8 (8.7%)		10 (3.7%)
Z-drugs	1 (25.0%)	0	0	2 (2.8%)	1 (1.1%)		4 (1.5%)
Medicinal opioids	0	1 (2.0%)	1 (2.0%)	2 (2.8%)	5 (5.4%)		9 (3.4%)
Benzodiazepines + medicinal opioids	0	0	0	0	1 (1.1%)		1 (0.4%)
Z-drugs + medicinal opioids	0	0	0	0	1 (1.1%)		1 (0.4%)
Alcohol only	1 (25.0%)	5 (10.0%)	8 (15.7%)	10 (14.1%)	7 (7.6%)		31 (11.6%)
Benzodiazepines + alcohol	0	1 (2.0%)	1 (2.0%)	2 (2.8%)	1 (1.1%)		5 (1.9%)
Z-drug + alcohol	0	0	0	1 (1.4%)	0		1 (0.4%)
Benzo + z-drug + alcohol	1 (25.0%)	0	0	1 (1.4%)	0		2 (0.7%)
Amphetamines + medicinal opioids + alcohol	0	0	1 (2.0%)	0	0		1 (0.4%)
Total	4	50	51	71	92		268

Note: One subject was not included in the above table as data about age and gender were not recorded

The distribution by gender showed to be unequal, with a significantly higher number of male drivers positive for one or more drugs. A significant difference was found for cannabis, alcohol and drug-alcohol combinations. Z-drugs were only found in female drivers, while cocaine only in male drivers.
As for age groups distribution, THC was most prevalent in the male groups 18-24 and 25-34. In females, THC was only found in the age group 18-24. Benzodiazepines were most found in drivers aged over 35. Medicinal opioids were equally distributed over all age categories. In female drivers alcohol was equally distributed over all age groups, whereas in male drivers there was a decrease with age. Combinations drug-alcohol in the male population were most found in subjects aged between 18 and 34 years, while for female drivers the distribution was equal over all ages.

The combination THC-alcohol was only found in male drivers, with the highest prevalence in the age groups 18-24 and 25-34. Alcohol and benzodiazepines were equally distributed over gender and age.

1.4.4 Distribution of substance groups by single- vehicle accidents vs. multi-vehicle accidents

Table 26. Distribution of substance groups by accident type

Type	Group	Single-Vehicle		Multi-Vehicle		unknown	
		n	%	n	%	n	%
None		298	57.2%	360	72.7%	20	32.8%
Alcohol	Alcohol	136	26.1%	55	11.1%	28	45.9%
Illicit Drugs	Amphetamines	3	0.6%	1	0.2%	1	1.6%
	Benzoylecgonine only	0	0%	3	0.6%	0	0%
	Cocaine (+BE)	1	0.2%	0	0%	0	0%
	THCCOOH only	3	0.6%	7	1.4%	1	1.6%
	THC (+THCCOOH)	13	2.5%	12	2.4%	2	3.3%
	Illicit opiates	0	0%	0	0%	0	0%
Medicinal drugs	Benzodiazepines	11	2.1%	13	2.6%	3	4.9%
	Z-drugs	0	0%	2	0.4%	2	3.3%
	Opiates and opioids	10	2.0%	14	2.8%	1	1.6%
Various combinations	Drug-alcohol	37	7.1%	25	5.1%	2	3.3%
	Drug-drug	9	1.7%	3	0.6%	1	1.6%
Total		522		495		61	

Table 27. Detailed substance group distribution by accident type

Substances		single-vehicle	multi-vehicle
	None	299 (57.3%)	360 (72.7%)
	Amphetamines only	3 (0.6%)	1 (0.2%)
	Benzoylecgonine only	0	3 (0.6%)
	Cocaine only	1 (0.2%)	0
	THCCOOH only	3(0.6%)	7 (1.4%)
	THC only	13 (2.5%)	12 (2.4%)
	Amphetamine + THC	1 (0.2%)	1 (0.2%)
	Benzoylecgonine +THC	1 (0.2%)	1 (0.2%)
	Amphetamine + benzoylecgonine + THC	1 (0.2%)	0
	Amphetamine + cocaine + THC	1 (0.2%)	0
	Benzodiazepines	11 (2.1%)	13 (2.6%)
	Amphetamine + THC + Benzodiazepine	0	0
	Z-drugs	0	2 (0.4%)
	Benzodiazepines +Z-drugs	1 (0.2%)	0
	Medicinal opioids	10 (1.9%)	14 (2.8%)
	Benzoylecgonine + medicinal opioids	0	1 (0.2%)
	THC + medicinal opioids	2 (0.4%)	0
	Benzodiazepines + medicinal opioids	1 (0.2%)	0
	Z-drugs + medicinal opioids	1 (0.2%)	0
	Alcohol only	136 (26.1%)	55 (11.1%)
	Amphetamines + alcohol	1 (0.2%)	0
	Benzoylecgonine + alcohol	1 (0.2%)	0
	Cocaine + alcohol	2 (0.4%)	0
	Amphetamines + cocaine + alcohol	1 (0.2%)	0
	THCCOOH + alcohol	3 (0.6%)	2 (0.4%)
	Benzoylecgonine + THCCOOH + alcohol	1 (0.2%)	0
	Cocaine + THCCOOH + alcohol	1 (0.2%)	0
	THC + alcohol	7 (1.3%)	7 (1.4%)
	Cocaine + THC + alcohol	1 (0.2%)	1 (0.2%)
	Benzodiazepines + alcohol	9 (1.7%)	11 (2.2%)
	Cocaine + Benzodiazepines + alcohol	1 (0.2%)	0
	THC + benzo + alcohol	1 (0.2%)	1 (0.2%)
	Amphetamines + THC + benzo + alcohol	0	1 (0.2%)
	Z-drug + alcohol	1 (0.2%)	1 (0.2%)
	Benzo + z-drug + alcohol	2 (0.4%)	1 (0.2%)
	Medicinal opioids + alcohol	2 (0.4%)	0
	Amphetamines + medicinal opioids + alcohol	1 (0.2%)	0
	THCCOOH + medicinal opioids + alcohol	2 (0.4%)	0
Total		522 (100.1%)	495 (99.8%)

Except for alcohol, for which prevalence was more than double in single-vehicle compared to multi-vehicle accidents, no statistically significant difference was found in the distribution of the other drugs and their combinations.

1.4.5 Distribution of substance groups by type of vehicle

Table 28. Distribution of substance groups by vehicle type

Substance group	Personal car		Van		Motor-cycle		Moped		Bicycle		Bust/ truck		Other	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
None	171	48.4	15	62.5	110	69.2	47	49.0	311	75.3	20	90.9	5	45.5
Alcohol	109	30.9	4	16.7	24	15.1	20	20.8	58	14.0	0	0	3	27.3
Amphe-tamines	3	0.8	0	0	1	0.6	0	0	1	0.2	0	0	0	0
Benzoyle c-gonine only	0	0	0	0	2	1.3	1	1.0	0	0	0	0	0	0
Cocaine (+BE)	0	0	0	0	0	0	0	0	1	0.2	0	0	0	0
THCCOOH only	3	0.8	0	0	3	1.9	5	5.2	0	0	0	0	0	0
THC (+THCCOOH)	6	1.7	0	0	6	3.8	8	8.3	6	1.5	0	0	1	9.1
Illicit opiates	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzodia -zepines	5	1.4	0	0	3	1.9	6	6.3	12	2.9	1	4.5	0	0
Z-drugs	3	0.8	0	0	0	0	0	0	1	0.2	0	0	0	0
Opiates and opioids	7	2.0	0	0	5	3.1	1	1.0	12	2.9	0	0	0	0
Drug-alcohol	40	11.3	3	12.5	5	3.1	6	6.3	9	2.2	0	0	1	9.1
Drug-drug	6	1.7	2	8.3	0	0	2	2.1	2	0.5	0	0	1	9.1
	353		24		159		96		413		22		11	

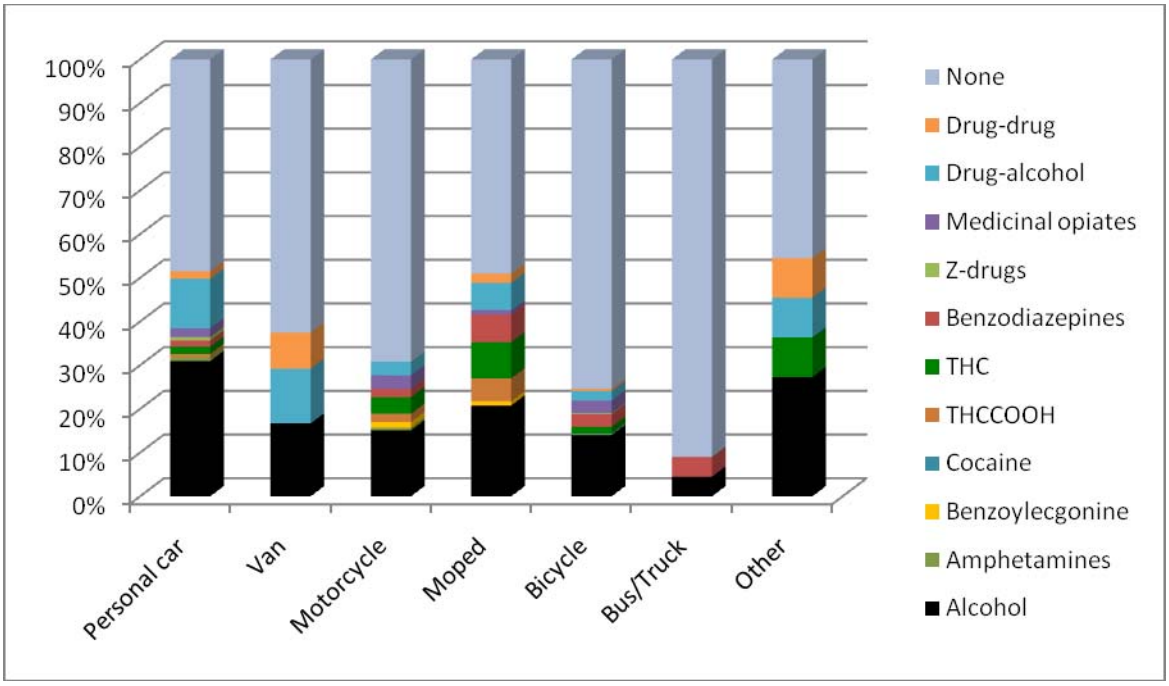


Figure 9. Distribution of substance groups by vehicle type

Alcohol was found more in drivers of a personal car compared to other vehicle types. Cannabis was equally distributed, except for vans, with zero positive cases, and moped, which had a slightly higher prevalence. No significant differences were found for benzodiazepines and medicinal opioids. The combination drug-alcohol was found more in personal car drivers than in drivers of other vehicle types.

Table 29. Detailed substance group distribution by type of vehicle

Substances	Vehicle type						
	personal car	van	motorcycle	moped	bicycle	bus/truck	other
None	171 (48.4%)	15 (62.5%)	110 (67.9%)	47 (49.0%)	311 (75.3%)	20 (90.9%)	5 (45.5%)
Amphetamines only	3 (0.8%)	0	1(0.6%)	0	1 (0.2%)	0	0
Benzoylecgonine only	0	0	2(1.3%)	1(1.0%)	0	0	0
Cocaine only	0	0	0	0	1 (0.2%)	0	0
THCCOOH only	3 (0.8%)	0	3(1.9%)	5(5.2%)	0	0	0
THC only	6 (1.7%)	0	6 (3.8%)	8(8.3%)	6 (1.5%)	0	1 (9.1%)
Amphetamine + THC	0	0	0	0	1 (0.2%)	0	1 (9.1%)
Benzoylecgonine +THC	1 (0.3%)	0	0	1(1.0%)	0	0	0
Amphetamine + benzoylecgonine + THC	1 (0.3%)	0	0	0	0	0	0
Amphetamine + cocaine + THC	0	1 (4.2%)	0	0	0	0	0
Benzodiazepines	5 (1.4%)	0	3 (1.9%)	6(6.3%)	12 (3.0%)	1 (4.5%)	0
Amphetamine + THC + Benzo	0	1 (4.2%)	0	0	0	0	0
Z-drugs	3 (0.8%)	0	0	0	1 (0.2%)	0	0
Benzodiazepines +Z-drugs	1 (0.3%)	0	0	0	0	0	0
Medicinal opioids	7 (2.0%)	0	5 (3.1%)	1 (1.0%)	12 (3.0%)	0	0
Benzoylecgonine + medicinal opioids	1 (0.3%)	0	0	0	0	0	0
THC + medicinal opioids	2 (0.6%)	0	0	0	0	0	0
Benzodiazepines + medicinal opioids	0	0	0	1 (1.0%)	0	0	0
Z-drugs + medicinal opioids	0	0	0	0	1 (0.2%)	0	0
Alcohol only	109 (30.9%)	4 (16.7%)	24 (15.1%)	20 (20.8%)	58 (14.0%)	1 (4.5%)	3 (27.3%)
Amphetamines + alcohol	1 (0.3%)	0	0	0	0	0	0
Benzoylecgonine + alcohol	1 (0.3%)	0	0	0	0	0	0
Cocaine + alcohol	2 (0.6%)	0	0	0	0	0	0
Amphetamines + cocaine + alcohol	0	1 (4.2%)	0	0	0	0	0
THCCOOH + alcohol	3 (0.8%)	0	1 (0.6%)	1 (1.0%)	0	0	0
Benzoylecgonine + THCCOOH + alcohol	1 (0.3%)	0	0	0	0	0	0
Cocaine + THCCOOH + alcohol	1 (0.3%)	0	0	0	0	0	0
THC + alcohol	11(3.1%)	0	1 (0.6%)	3 (3.1%)	1 (0.2%)	0	0
Cocaine + THC + alcohol	1 (0.3%)	1 (4.2%)	0	0	0	0	0
Benzodiazepines + alcohol	13 (3.7%)	0	2 (1.3%)	1 (1.0%)	4 (1.0%)	0	0
Cocaine + Benzodiazepines + alcohol	1 (0.3%)	0	0	0	0	0	0
THC + benzo + alcohol	1 (0.3%)	0	0	0	1 (0.2%)	0	0
Amphetamines + THC + benzo + alcohol	1 (0.3%)	0	0	0	0	0	0
Z-drug + alcohol	0	0	0	1 (1.0%)	1 (0.2%)	0	0
Benzo + z-drug + alcohol	2 (0.6%)	0	0	0	0	0	1 (9.1%)
Medicinal opioids + alcohol	0	1 (4.2%)	0	0	1 (0.2%)	0	0
Amphetamines + medicinal opioids + alcohol	0	0	1 (0.6%)	0	0	0	0
THCCOOH + medicinal opioids + alcohol	1 (0.3%)	0	0	0	1 (0.2%)	0	0
Total	353 (100.2%)	24 (100.2%)	159 (100.0%)	96 (99.7%)	413 (99.8%)	22 (100.0%)	11 (100.1%)

The prevalence for THC combined with alcohol was significantly higher in personal car drivers than in motorcycle or bicycle riders. The distributions for this combination were

equal for the two-wheel vehicle drivers. The distribution of the combination benzodiazepines + alcohol was lower in bicycle riders.

1.4.6 Distribution of additional substances

Beside the core substances, additional substances were analysed. A list of the additional analytes can be found in the summary report, under the method part.
The number of positive cases for the additional substances is shown in table 30.
Positive cases for tramadol, 7-aminoclonazepam and 7-aminoflunitrazepam, 3 analytes of the additional substances list, were incorporated in the result calculations of the core substances, under the groups opiates and opioids (tramadol) and benzodiazepines (7-aminoclonazepam and 7-aminoflunitrazepam).

Table 30. Number of positive cases for additional substances

Substance	Number of cases
Amitriptyline	2
Bromazepam	6
Buprenorphine	0
Citalopram	35
Mirtazapine	7
11-OH-THC	49
Trazodone	18
Total	117

In total 117 cases were found positive for additional substances. Hydroxy-THC and citalopram represented the major additional findings.

Table 31. Distribution of additional substances by region

	Region		
	Brussels	**Flanders**	**Wallonia**
Positive for additional substances	4 (11.4%)	86(9.8%)	27 (16.2%)
Total injured drivers	35 (100%)	876 (100%)	167 (100%)

There was no significant difference in prevalence of additional substances between Brussels and Flanders nor between Brussels and Wallonia. A slight difference was found between Flanders and Wallonia.

Table 32. Distribution of additional substances by Day vs Night

	Day vs. night		
	unknown	**Day**	**Night**
Positive for additional substances	3 (17.6%)	95(10.6%)	19 (11.6%)
Total injured drivers	17 (100%)	897 (100%)	164 (100%)

No significant difference was found in the distribution of additional substances both between day and night (Table 32) and between week and weekend (Table 33). A possible explanation is that, apart form 11-OH-THC, all extra substances are medicinal drugs, likely to be taken on a regular basis.

Table 33. Distribution of additional substances by Week vs Weekend

	Week vs. weekend		
	unknown	**week**	**weekend**
Positive for additional substances	3 (17.6%)	69 (10.8%)	45 (10.6%)
Total injured drivers	17 (100.0%)	639 (100.0%)	422 (100.0%)

Table 34. Distribution of additional substances by age and gender

Gender	**Age groups**						
	unknown	**17y**	**18-24**	**25-34**	**35-49**	**50+**	**Total**
Male positive for additional substance	5 (31.3%)	1 (25.0%)	22 (14.4%)	22 (12.6%)	19 (8.1%)	12 (5.3%)	81 (10.0%)
Total injured males	16 (100%)	4 (100%)	153 (100%)	175 (100%)	236 (100%)	225 (100%)	809 (100%)
Female positive for additional substance	1 (25.0%)	0	4 (8.0%)	6 (11.8%)	8 (11.3%)	17 (18.5%)	36 (13.4%)
Total injured females	4 (100%)	0	50 (100%)	51 (100%)	71 (100%)	92 (100%)	268 (100%)

There was no significant difference in distribution of additional substances between male and female drivers. Within the male subpopulation additional substances were found less often over 34 years (age groups 35-49 and 50+).
For females distribution of additional substances was found equal over the 4 different age groups.

Table 35. Distribution of additional substances by accident type

	Accident type		
	unknown	**single-vehicle**	**multi-vehicle**
Positive for additional substances	7 (11.5%)	56 (10.7%)	54 (10.9%)
Total injured drivers	61 (100.0%)	522 (100.0%)	495 (100.0%)

As for accident type, distribution of additional substances was equal between single and multi-vehicle crash.

1.4.7 Distribution of substance concentrations

Distribution of concentrations is reported in the tables below for DRUID core substances and for additional substances separately.

Core substances

Table 36. Concentration distribution of core substances (above DRUID cut-off)

Substance	Number of cases	Concentration range (ng/mL)		Median (ng/mL)	Mean (ng/mL)
		Min	Max		
Ethanol	283	0.10 g/L	4.29 g/L	1.59 g/L	1.58 g/L
Morphine	12	10.5	104.9	17.7	35.6
Amphetamine	13	21.9	1327.6	300.2	377.9
MDMA	2	389.1	436.4	412.8	412.8
MDA	1	43.4	43.4		
Cocaine	9	13.3	54.5	37.5	34.5
THC	57	1.0	14.2	2.5	2.9
Diazepam	19	20.1	373.9	131.4	154.4
Alprazolam	5	10.4	42.9	13.5	22.3
Clonazepam	3	13.5	18.8	14.3	15.5
Benzoylecgonine	18	54.5	1252.1	309.7	367.5
Codeine	4	13.8	78.8	23.9	35.1
6-acetylmorphine	0				
Metamphetamine	0				
Methadone	5	17.2	53.1	45.9	42.3
Oxazepam	5	55.2	227.0	73.6	101.7
Nordiazepam	25	27.9	500.0	141.9	162.0
Zolpidem	10	22.9	436.0	88.6	135.4
MDEA	0				
THC-COOH	74	5.5	87.4	17.1	23.1
Lorazepam	19	12.0	268.9	30.3	47.4
Flunitrazepam	1	5.9	5.9		
Zopiclone	1	10.5	10.5		
7-a-clonazepam	6	21.4	65.4	29.5	37.4
7-a-flunitrazepam	1	33.6	33.6		
Tramadol	18	56.2	6048.9	273.7	1062.6

Additional substances

Table 37. Concentration distribution of additional substances (above DRUID cut-off)

Substances	Number of cases	Concentration range (ng/mL)		Median (ng/mL)	Mean (ng/mL)
		Min	Max		
Amitriptyline	2	15.9	53.4	34.7	34.7
Bromazepam	6	35.0	140.6	82.6	84.8
Buprenorphine	0				
Citalopram	35	6.1	459.6	41.8	65.8
Mirtazapine	7	6.9	39.3	32.8	26.8
11-OH-THC	49	1.0	31.7	2.0	2.8
Trazodone	18	22.1	190.7	57.5	69.9

Maximum concentrations for some pain management drugs, such as tramadol and morphine, appeared to be relatively high to result from normal therapeutic use. In a previous study on drug-impaired driving[20], the average concentration for tramadol was found to be around 500 ng/mL. Also, according to the scientific literature, concentrations of morphine in the range of 20 ng/mL are normally considered sufficient for pain management in cancer patients. The maximum concentrations found in this study for tramadol and morphine appear more likely to be in the range of those found during emergency treatment than in normal pain management. This observation leads to the possibility that, in a few cases, the administration of drugs prior to blood sampling may have not been recorded on the patient form.

1.5 Discussion of results

1.5.1 Representativeness

The study area covers most of Belgium. Samples for this hospital study were collected in the same regions where the sample collection for the roadside survey took place (D 2.2.3.). But with a low number of samples that was collected in Liège and Brussels. National data from 2006 were available on the distribution of injured drivers by quarter of the year (see 1.1.6). A slight difference could be noticed between the data sets collected in 2006 in the third and fourth quarters of the year and those collected in the present study in the same time frames.
Since the response rate was high, it is safe to assume that non-response did not influence the representativeness of the sample.
In the present study, bicycle riders constituted a high portion of the sampled population. This may have had an influence on the general outcomes of the toxicological findings, as the percentage of negative cases was the highest among this subpopulation.

1.5.2 Effects of non-response

Even if its size may have been underestimated to some extent for the reasons reported above, it is unlikely that the non-response had a significant effect on the distribution of the results of the present study.

1.5.3 Highlights

Alcohol was the most prevalent substance among injured drivers in Belgium, with a percentage of 26.2. Almost 23% of alcohol positive cases were positive for a drug-alcohol combination. Cases positive for alcohol only were more common in male drivers, with prevalence decreasing as age increased. The second most prevalent group was the one positive for cannabis only (3.5%), with positive cases more common in the male subpopulation aged 18-34. The combination alcohol-cannabis was not found in the female population.
In general the number of positive drivers was higher during night-time. Alcohol alone and in combination with cannabis was found more during nights (with a prevalence 3.6 times higher than in daytime accidents). Accidents involving drivers positive for cannabis only occurred more often during daytime. In general, analyses revealed more positive cases during weekends than during weekdays, with an occurrence of alcohol that was almost double during weekends compared to weekdays.
When comparing accident type, drivers involved in single-vehicle accidents were found positive for one or more substances 1.6 times more often than drivers involved in multiple-vehicle crashes.

[20] Baselt RC. Disposition of toxic drugs and chemicals in man. Biomedical publications Foster city, California, 2004

Big differences among vehicle types were observed. Alcohol was most prevalent among drivers of personal cars, while the percentage of subjects testing positive for THC was the highest in the subpopulation of moped drivers

1.5.4 Comparison to other studies

A study similar to the one presented in this report was carried out in Belgium between January 1995 and June 1996, under the name of Belgian Toxicology and Trauma Study (BTTS). BTTS collected data about drivers of motor vehicles and bicycles, aged more than 14 years, involved in traffic accidents that led at least to 24 hour hospitalisation. In the BTTS toxicological analyses were performed on blood and urine samples taken from injured drivers conveyed to the same 5 hospitals selected in the present project.
When comparing the findings of the present study to the ones of the BTTS, no significant difference can be found in gender distributions. Regarding time period distribution, the percentage of accidents recorded during weekdays is lower in the DRUID-project. As for vehicle type, cars, vans and motorcycles are more represented in the BTTS, with a higher prevalence of multiple-vehicle accidents, while a higher proportion of bicycles, mopeds and trucks are recorded in the present study. Use of seat belt appears to have stayed equal.
In the toxicological analyses, alcohol remains the most common finding. The percentage of BAC above 0.5 g/L decreases from 28% in the BTTS to the present 23%, but is linked to an increased prevalence among younger people (the higher prevalence shift from age groups 35-39 and 50-54 to age groups 25-34 and 35-49). THC use is consistent in the two studies. Cocaine prevalence appears to be higher in the DRUID sample compared to the BTTS findings, while amphetamines, benzodiazepines and medicinal opioids incidence decrease. A limitation of the BTTS is the screening and confirmation of illicit drugs in urine instead of blood. It is possible that a certain number of drivers was found positive because they had taken drugs several days before the accident. Comparison with blood results in DRUID should therefore be made cautiously.

1.6 Acknowledgements

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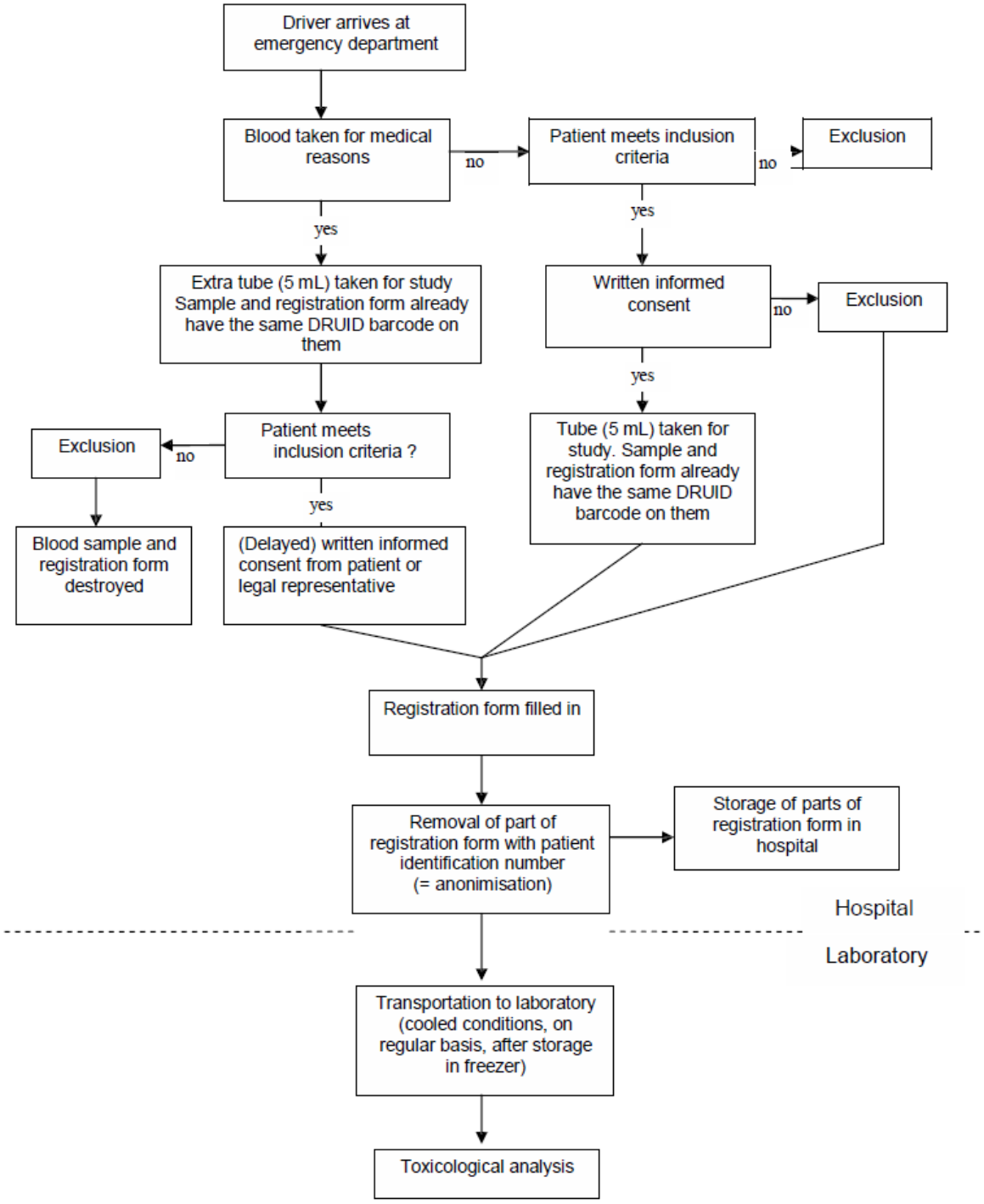
- Dr. Albert Fox, Mr. Vincent Collet, Mr. Johan Silliard & Mr. Eric Lahaye - Regional Hospital of Namur

1.7 References

1. Studie van de uitwendige oorzaken in de minimale klinische gegevens (2010). Figures from 2006
2. BTTS: Belgian Toxicology and Trauma Study. Meulemans A, Hooft P, Van Camp L, De Vrieze N, Buylaert W, Verstraete A, Vansnick M. 1998

1.8 Annex 1 : Flow chart



1.9 Annex 2 : Patient Form

Registration forms are available in Dutch and French. This annex only includes a translation to English. The registration form can be printed on 1 recto-verso sheet. The upper part (which includes a Patient Identification Number) has to be removed before sending the forms to the DRUID researchers.

DRUID Registration form	Date: _ _ - _ _ - 200 _
Inclusion criteria:	▫Patient has MAIS ≥ 2 EN ▫Patient was driving a motorized vehicle or bicycle EN ▫Patient was not transferred from another hospital (only primary admissions) EN ▫Admission because of traumatological reasons EN ▫Patient is 18 years or older
PIN	XXXX

Remove upper part before sending form to DRUID researchers

DRUID-number	XXXXXXXX XXXXXXXXX		
	⋯ refusal to participate (reasons:.....)		
Hospital	⋯ UZ Gent	⋯ UZ Leuven	⋯ UZ Brussel
	⋯ CHU Liège	⋯ CHR Namur	
Date of accident	..... (day) ..... (month) 200..... (year)		
Time of accident	_ _ : _ _ (hh:mm)	*Time of admission or arrival of ambulance*	_ _ : _ _ (hh:mm)
Vehicle type patient	⋯ passenger car	⋯ small van	⋯ truck/bus
	⋯ motorcycle	⋯ moped	⋯ bicycle
	⋯ unknown	⋯ other:.....	
Counterpart	⋯ passenger car	▫ small van	▫ truck/bus
	⋯ motorcycle	▫ moped	▫ pedestrian
	⋯ fixed object (no other vehicle)	▫ animal	▫ bicycle
	⋯ unknown	▫ other:.....	
Address of accident	..... (road + nr)		
	..... (city)		
Speed limit at accident location (km/h)	⋯ ≤ 30	▫ 40-50	▫ 60-90 ▫ ≥ 100 ▫ unknown
Safety belt used by patient	⋯ yes	⋯ no	⋯ not applicable ⋯ unknown

Weather	··· dry	··· rain	··· fog
	··· snow	··· hail	··· unknown
	··· other:.....		
Road surface	··· dry	··· wet	··· dirty (sand, gravel, leaves)
	··· snpw	··· ice	··· unknown
	··· other:		
Injury severity on admission to Emergency Dept	**MAIS** _____	GCS _____	RTS (total) _____
Medication administered before blood sampling	Name (generic):		Dose:
	··· Analgesics: _____		_____
	··· Hypnotics: _____		_____
	··· Sedatives: _____		_____
	··· Others: _____		_____
	··· I.V. fluid: _____		_____L (volume)
	··· Unknown		

Gender	··· Male ··· Female	*Age*	*Time of blood sampling (hh:mm)*	_ _ : _ _

Highest obtained degree	··· primary education	··· higher education, short type
	··· secondary education, not finished	··· higher education, long type
	··· secondary education, finished	··· university

Outcome for patient	··· discharged	··· hospitalized	··· deceased

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1.10 **Annex 3 :Toxicological analysis of blood samples**

1.10.1 Extraction

1.10.1.1 Whole blood – cannabinoids

Internal standard (25ng/mL) was added to 1000µL of blood, together with 100µL H_2O, 50µL methanol and 100µL acetic acid 10%.
5.5 mL hexane/ethyl acetate (90/10) was added. After 30 min rolling and centrifugation (3000 rpm, 5 min) the organic phase was removed, transferred to a silanised tube and evaporated under nitrogen at 56°C. The dry residue was resuspended in 200µL TMAH/DMSO (100mg Trimethylammoniumhydroxide in 1.9 mL Dimethylsulfoxide + 0.1 mL H_2O). After 5 min incubation (ambient temperature) 50µL methyliodide was added. After 1h incubation (ambient temperature) 200µL HCl 0.1N was added to stop the derivatisation reaction. After 5 min incubation 2 mL iso-octane was added, the samples were rolled for 10 min and centrifuged for 5 min. The organic phase was removed, evaporated under nitrogen at 56°C, reconstituted in 30µL ethyl acetate and transferred into a vial for analysis with GC-MS.

1.10.1.2 Whole blood – other substances

Whole blood samples were extracted using solid phase extraction (SPE). Internal standard (20 ng/mL) was added to 500 µL of blood which was diluted using 2.5 mL ammonium acetate (0.05M, pH 4.1)/methanol (80:20). After centrifugation, this mixture was loaded on Bond Elut Plexa PCX cartridges (3 mL, 60mg) (Varian, Sint-Katelijne-Waver, Belgium) previously conditioned with 2 mL of methanol and 2 mL of H_2O. Cartridges were washed consecutively with 2 mL H_2O and 4 mL methanol/H_2O (1:1). Cartridges were dried under vacuum and analytes were eluted using 4.5 mL acetonitrile with 2% ammonia. Samples were evaporate at room temperature, reconstituted in 100 µL methanol/ H_2O (1:1) and transferred into a vial for analysis with UPLC-MS/MS.

1.10.2 UPLC-MS/MS parameters

Separation and detection were performed using an ultra-performance liquid chromatography tandem mass spectrometer (UPLC-MS/MS).
Chromatographic separation was performed on an Acquity™ ultra performance liquid chromatograph (Waters, Zellik, Belgium). The system was equipped with an Acquity UPLC BEH C18 column (1.7µm, 2.1 x 100 mm) and a Vanguard BEH C18 pre-column (1.7µm, 2.1 x 5 mm). A gradient elution of water with 2mM ammonium bicarbonate pH 9.3 (A) and methanol (B) was used. The column oven was heated to 60°C. Injection was performed using partial loop using needle overfill mode. Ten µL were injected for whole blood samples. Both the ratio between aqueous and organic solvent and total flow-rate were changed over time. Total run-time including re-equilibration was 7 min. (figure 9)

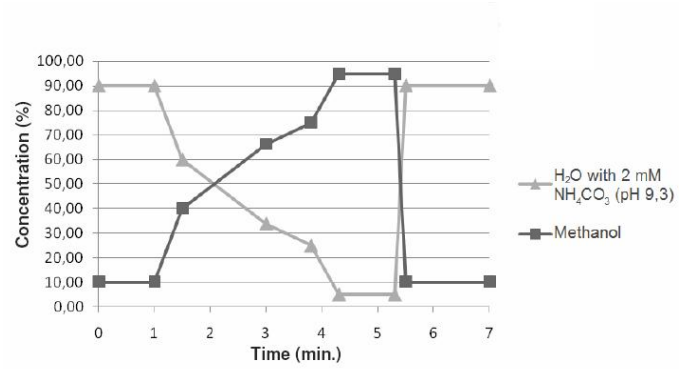

Figure 9. Mobile phase gradient used for UPLC

Detection was performed using a Waters Quattro Premier XE tandem mass spectrometer. The general source parameters used are given in Table 1.

Table 1. General parameters used for mass spectrometry

ES+ Source	Capillary Voltage	0.8 kV
	Extractor Voltage	4 V
	RF Lens	0 V
	Source Temperature	140 °C
	Desolvation Temperature	450 °C
	Desolvation Gas Flow	1000 L/h
	Cone Gas Flow	50 L/h
Analyser	Collision Gas Flow	0.15 mL/min

To determine component-dependent mass spectrometric parameters, all analytes were infused separately. Retention time windows were defined as the retention time ± 0.15 min for all analytes except amphetamines (± 0.35 min). For each analyte, the maximum dwell times were chosen at which a minimum of twelve data points per peak was obtained for all analytes. MRM transitions, collision energies, cone voltages, retention times and dwell times are shown in Table 2.

Table 2. MRM transitions, dwell times, cone voltage, collision energy and retention times for all standards and internal standards

Substance	Q 1	Q 3	Dwell time (msec)	Cone (V)	Collision Energy (eV)	Retention time (min)
6-acetylmorphine	328.12	152.08	35	47	61	3.61
6-acetylmorphine-D3	331.10	164.90	35	45	37	3.58
7-amino-clonazepam	286.08	222.05	35	41	25	2.79
7-amino-clonazepam-D4	290.02	226.00	35	39	27	2.78
7-amino-flunitrazepam	284.14	226.86	35	39	25	2.96
7-amino-flunitrazepam-D7	291.11	230.30	35	39	27	2.94
Alprazolam	309.01	204.94	25	49	39	4.34
Amitriptyline	278.14	233.07	25	33	17	5.33
Amitriptyline-D3	281.10	233.00	25	33	17	5.33
Amphetamine	136.07	119.05	35	15	9	3.43
Amphetamine-D5	141.01	92.90	35	17	27	3.37
Benzoylecgonine	290.14	168.00	35	33	19	2.64
Benzoylecgonine-D3	293.10	171.00	35	33	19	2.63

Bromazepam	316.03	181.96	30	41	29	3.91
Buprenorphine	468.26	55.27	25	55	49	5.51
Buprenorphine-D4	472.23	83.00	25	63	53	5.50
Citalopram	325.11	262.10	25	37	25	4.79
Clonazepam	316.08	269.96	30	45	25	4.02
Cocaine	304.11	182.1	15	31	19	4.66
Cocaine-D3	307.10	185.00	15	31	19	4.64
Codeine	300.14	165.01	30	41	43	3.84
Codeine-D3	303.10	215.00	30	45	25	3.83
Diazepam	285.08	222.02	25	43	27	4.71
Diazepam-D5	290.08	227.00	25	43	27	4.69
Flunitrazepam	314.08	268.09	30	41	25	4.09
Lorazepam	321.02	229.03	40	29	29	4.30
MDA	180.02	105.03	35	15	21	3.28
MDA-D5	185.01	110.00	35	17	21	3.23
MDEA	208.10	162.97	30	23	13	3.79
MDEA-D5	213.07	162.90	30	21	13	3.69
MDMA	194.10	162.95	35	21	13	3.43
MDMA-D5	199.10	135.20	35	21	21	3.34
Methadone	310.27	265.13	25	31	15	5.30
Methadone-D3	313.21	268.10	25	29	15	5.29
Methamphetamine	149.96	90.95	30	21	17	3.61
Methamphetamine-D5	155.00	120.90	30	19	11	3.55
Mirtazapine	266.10	195.00	25	37	25	4.83
Morphine	286.11	152.10	35	45	53	3.10
Morphine-D3	289.08	164.90	35	43	37	3.10
Nordiazepam	271.02	208.03	25	41	25	4.58
Oxazepam	287.05	241.01	40	33	25	4.31
THC	315.18	193.05	60	31	21	5.44
THC-d3	318.13	196.00	20	31	25	5.44
Tramadol	264.18	58.18	25	27	15	4.59
Tramadol-^{13}C-D3	268.14	58.20	25	25	15	4.58
Trazodone	372.08	176.0	25	43	23	4.86
Zolpidem	308.21	235.10	40	43	35	4.30
Zolpidem-D6	314.18	263.10	40	53	27	4.28
Zopiclone	389.03	244.92	30	17	17	3.94

1.10.3 GC-MS parameters

Detection of THC, 11-OH-THC and THCCOOH, was performed on an Agilent 6890 N gas chromatograph with split injection and a quadrupole mass spectrometer (Agilent 5973).
Analytes were separated on a GC capillary column (Agilent 127-100ADB1, 5m x 0.10mm), in constant flow mode with an initial flow of 0.4ml/min.
The components are identified/quantified using qualifier ions in combination with their retention time (Table 3).

Table 3. Retention time, target ion, qualifier ions and dwell time for GC-MS of cannabinnoids in blood

Substance	Retention Time	Target ion	Qualifier ions	Dwell time
THC	2.97	328	313, 285	50
THC.D3	2.97	331	316, 288	50
11-OH-THC	3.25	313	/	10
11-OH-THC.D3	3.25	316	/	10
THCCOOH	3.47	357	313, 372	10
THCCOOH.D3	3.47	360	316, 375	10

1.10.4 Validation

1.10.4.1 LC-MS/MS

Whole blood was collected from drug-free volunteers in the same containers as used in the hospital study.

Selectivity was tested by injecting ten blank samples from different sources to check for interfering signals. No interfering signals were observed.
Nine calibration points were used: 0, 0.5, 1, 5, 10, 20, 50, 100 and 200 ng/mL; best fitting regression model and weighting factors were determined based on 5 replicate injections of each concentration level.

Accuracy and precision at DRUID cut-off were determined based on 6 injections at the DRUID cut-off concentration. Since the CV on the response of these injections is below 15%, the LLOQ (lower limit of quantification) of the method is below the DRUID cut-off for all analytes.

To measure absolute and relative matrix effects, blood samples were collected from 10 different volunteers. Five replicates were used. Absolute matrix effect was defined as the ratio between peak areas of samples spiked after extraction compared to injections of spiked mobile phase. To determine if the absolute matrix effect has an influence on quantification of analytes, the relative matrix effect was defined as described by Matuszewski[21]: calibration lines were prepared in whole blood from five different volunteers. Slopes from the standard lines were determined. It is recommended that the CV of these slopes does not exceed 3-4% in order to conclude that the method is not affected by relative matrix effects. This value was lower than 2% for all analytes for which a deuterated internal standard was used. The analytes without deuterated internal standards were more affected by relative matrix effects, but were below 4% in all cases except for citalopram, which is significantly more affected by matrix effects. However, when this method was developed, deuterated citalopram was not available to be used as internal standard.

All validation parameters are described in table 5

Legend for table 5:

[21] Matuszewski et al. J Chromatogr B Analyt Technol Biomed Life Sci 2006 ; 830(2) :293-300

* extraction yield at medium concentration (20 ng/mL)
§ inaccuracy and imprecision at DRUID cut-off
[Ω] absolute matrix effect determined at 100 ng/mL
[$] CV of slopes of standard lines from five different sources

1.10.4.2 GC-MS[22]

Whole blood was collected from drug-free volunteers in a Venoject 5mL container (ref VT-050SFX), the same as used during the hospital study.

Selectivity was tested by injecting five blank samples from different subjects to check for interfering signals. For four samples no interfering signals were observed, one sample showed a signal for THCCOOH that was below the DRUID cut-off.

Accuracy and precision were determined based on 14 injections at low concentrations (THC and OH-THC: 1.5 ng/mL and THCCOOH 7.5 ng/mL) and 14 injections at high concentrations (THC and OH-THC: 8 ng/mL and THCCOOH 40 ng/mL). At low concentration inaccuracy was below 5% for all compounds, at high concentration inaccuracy was below 15% for THC and OH-THC and below 17% for THCCOOH. Imprecision was below 6% for all compounds at low and high concentration.

Extraction efficiency for each analyte was determined at low (n=4) and high (n=4) concentrations (THC and OH-THC 1.5 and 8 ng/mL respectively; THCCOOH 7.5 and 40 ng/mL). Relative recovery was assessed by adding internal standard (IS) working solution to one set of spiked samples before extraction and to the second set after extraction but prior to evaporation. Samples were derivatised and analysed. The relative extraction efficiency was calculated by comparing the peak area ratios of analyte to internal standard for each compound in the first set with the appropriate peak area ratios in the second. Recovery was 50% or higher for all compounds.

The validation parameters are described in table 4.

Table 4. Validation parameters for GC-MS confirmation method

		Intra assay (n=9)			Inter assay (n=14)			
Analyte	**Nominal concentration (ng/mL)**	**Mean (ng/mL)**	**Inaccuracy %**	**Imprecision %**	**Mean (ng/mL)**	**Inaccuracy %**	**Imprecision %**	**Recovery ± SD (%)**
THC	1.5	1.50	0.2	4.32	1.54	4.2	5.61	52.59 ± 6.74
	8	7.90	11	2.26	7.89	-11	2.77	53.12 ± 9.74
OHTHC	1.5	1.54	4.2	3.83	1.53	3.2	3.17	51.11 ± 1.10
	8	7.95	-9.6	0.95	7.90	-12	1.74	62.08 ± 5.79
THCCOOH	7.5	7.45	-4.5	1.12	7.45	-4.6	1.73	58.45 ±

[22] Steinmeyer S, Bregel D, Warth S, Kraemer T, Moeller MR. Improved and validated method for the determination of delta-9-tetrahydrocannabinol (THC), 11-hydorxy-THC and 11-nor-9-carboxy-THC in serum, and in human liver microsomal preparations using gas chromatography-mass spectrometry. Journal of Chromatography B 2002; 772: 239-248.
Gustafson RA, Moolchan ET, Barnes A, Levine B, Huestis MA. Validated method for the simultaneous determination of delta9-tetrahydrocannabinol (THC), 11-hydorxy-THC and 11-nor-9-carboxy-THC in human plasma using solid phase extraction and gas chromatography-mass spectrometry with positive chemical ionisation. Journal of Chromatography B 2003; 798: 145-154.

								5.63
	40	39.97	-16.9	1.77	39.83	-16	1.97	49.67 ± 2.27

Table 5. Validation parameters for UPLC-MS/MS confirmation method

	Whole blood					
	R^2	Extraction yield* (%)	Inaccuracy § (%)	Imprecision § (%)	Absolute matrix effect (%)£	Relative matrix effect$ (CV)
6-acetylmorphine	0.991	81.8	-8.4	8.2	-42.0	1.9
7-amino-clonazepam	0.995	49.7	6.4	2.8	-24.7	1.0
7-amino-flunitrazepam	0.995	56.5	-10.5	4.4	-41.2	0.9
Alprazolam	0.990	72.5	0.8	3.7	-23.2	0.9
Amitriptyline	0.997	54.7	6.6	2.5	-26.2	1.2
Amphetamine	0.994	20.0	-4.9	8.3	-16.1	1.3
Benzoylecgonine	0.997	22.0	3.2	2.3	-14.0	1.3
Bromazepam	0.994	78.4	2.9	8.4	-18.9	1.8
Buprenorphine	0.995	41.7	-8.6	10.2	-34.0	1.3
Citalopram	0.993	73.7	0.8	5.9	-37.6	5.5
Clonazepam	0.992	67.2	-10.3	2.2	-47.7	1.7
Cocaine	0.998	77.2	4.1	2.4	-6.4	1.8
Codeine	0.996	80.0	1.6	3.6	-48.9	1.7
Diazepam	0.996	67.0	-9.9	2.0	-34.6	1.7
Flunitrazepam	0.990	70.2	-4.1	2.4	-31.2	1.9
Lorazepam	0.982	51.9	14.0	3.5	-24.7	2.0
MDA	0.991	79.6	-7.8	8.6	-39.3	1.6
MDEA	0.995	72.2	-3.6	3.7	+37.9	1.2
MDMA	0.986	56.3	-5.1	7.2	-35.3	1.8
Methadone	0.990	56.6	-0.3	2.7	-3.9	1.4
Methamphetamine	0.994	5.3	-1.0	3.7	-11.8	2.2
Mirtazapine	0.997	63.9	9.5	6.1	-13.1	3.0
Morphine	0.988	59.0	-5.0	7.2	-23.1	1.6
Nordiazepam	0.997	71.5	10.0	2.4	-21.5	1.3
Oxazepam	0.992	69.2	5.9	4.7	-26.5	2.1
THC	NA	NA	NA	NA	NA	NA
Tramadol	0.997	82.7	5.7	2.7	+7.5	1.5
Trazodone	0.997	96.7	-14.9	4.7	-39.8	2.3
Zolpidem	0.995	84.7	-2.2	2.0	-3.1	0.9
Zopiclone	0.990	84.2	10.2	3.7	-33.0	3.4

1.10.5 Ethanol analyses

Ethanol was quantified using the Ethanol Gen.2 enzymatic method on a Roche Cobas Integra 400 system.

Whole blood samples were first precipitated using trichloroacetic acid.

1.10.6 ELISA method

Cannabinoids were analysed using Elisa One Step Cannabis (IDS, Cat No. TH-96-CE-U. The kit contains an enzyme conjugate (horseradish peroxidase), an enzyme diluent (containing a pharmaceutical stabiliser in PBS buffer), a washing solution (containing Tween-20 in a PBS buffer; which is diluted 1:10 before use), a substrate (containing 3,3',5,5'-Tetramethylbenzidine) and a stop solution (3N H_2SO_4)

20µL of the whole blood samples were deposited into a well each. Per plate 4 control samples were added with concentration of 0, 0.5, 1 and 5 ng/mL.

100µL of the diluted enzyme were added to the wells. After the plate was incubated at ambient temperature for 30 min, the plate was turned over to empty the wells. 300µL of washing solution were added and the plate was turned over. After this, a washing step was performed 3 times, 150µL of substrate were added to each well, and the plate was incubated at ambient temperature for 15 min. 150µL stop solution were added. The optical density of each well was read using a micro-plate reader (Behring BEP3 Elisa processor) with a measurement filter of 450 nm (reference filter of 650 nm).

When the optical density value was lower or equal to the positive control of 5ng/mL, confirmation analysis was performed with the GC-MS method on the corresponding blood sample.

2 Country Report Denmark

Authors
Hospital study information: Inger Marie Bernhoft, Tove Hels and Kira Janstrup, Technical University of Denmark, Department of Transport.
Toxicological analyses: Kirsten Wiese Simonsen and Anni Steentoft, University of Copenhagen.

2.1 Description of the hospitalised driver study population

2.1.1 Introduction

The hospital study in Denmark fully complies with the general guidelines mentioned in Annex 1 of the Summary Report. The main survey was carried out in the period 1 October 2007 – 31 March 2010 in five selected hospitals. The personnel in the hospitals were in charge of the inclusion of patients in the study.

Only drivers of passenger cars and vans were included in the study and only drivers who fulfilled the Danish criterion of being a “trauma-patient”. Two or more points on the Danish trauma scale indicates that the patient will be treated as a trauma patient and that laboratory technicians will take blood samples from the patient as part of the treatment. The Danish trauma scales differ from the international accident injury scale, but it is assumed that 2 points equals MAIS=2.

On arrival of the patient, the emergency room secretary controlled, whether the patient fulfilled the inclusion criteria for DRUID:

- Driver of passenger cars and small vans up to 3500 kg (driving licence category B), who was brought to the hospital after a road traffic accident
- Injured in traffic accident on public road
- Minimum age: 18 years
- Only primary admissions
- Admission because of traumatological reasons (based on the Danish trauma score)
- Time interval between admission and sampling is less than 3 hours
- Severity of injuries: Trauma score of the hospital

If this was the case, the emergency room secretary filled in a patient datasheet and the laboratory technician took besides the samples for treatment purposes an additional blood sample. The blood collection device and the patient datasheet carried the same DRUID ID-bar code. Ethanol swabs were not used for cleaning. The blood samples were stored in the deep freezer at -20^{o} C until they were picked up by the project courier on a regular basis and transported on ice to the DRUID partner University of Copenhagen for further storage and analysis. After completion in the hospital, each patient datasheet was mailed separately to DTU by the emergency room secretary.

DTU prepared an information leaflet for the patients. However it was the decision of the hospital whether patients should receive the information. Driver participation in the hospital study was, in principle, voluntary. However, the blood sample was taken on arrival during the normal procedure for blood samples, and the patient was not informed or asked permission. Because of the severity of injuries, some of the trauma patients were even unconscious at the sampling time.

There is no information on the number of cases that the hospitals missed because of time pressure or for some other reason did not include in the study sample. However, for about 60 patients, either patient information or blood sample was missing, so this number of missing cases is considered a minimum.

Reasons for missing samples could be: the patient datasheet showed that the person did not meet the criteria for inclusion, the tube for the blood sample was broken so the sample could not be analysed, the blood sample was considered not relevant and discarded in the hospital or simply that, for a specific DRUID bar code, either blood sample was not taken or the patient datasheet was not submitted to DTU.

The total number of seriously injured drivers for whom both a datasheet was received in DTU and a blood sample was received in UKBH was 856. Four drivers were below the age of 18. These drivers were excluded from the study population that comprises in total 852 drivers.

2.1.2 Geographic distribution of drivers over the country

Five hospitals participated in the survey:

- Region 1: Aalborg and Viborg
- Region 2: Kolding, Vejle and Odense.

No hospitals from region 3 took part in the study

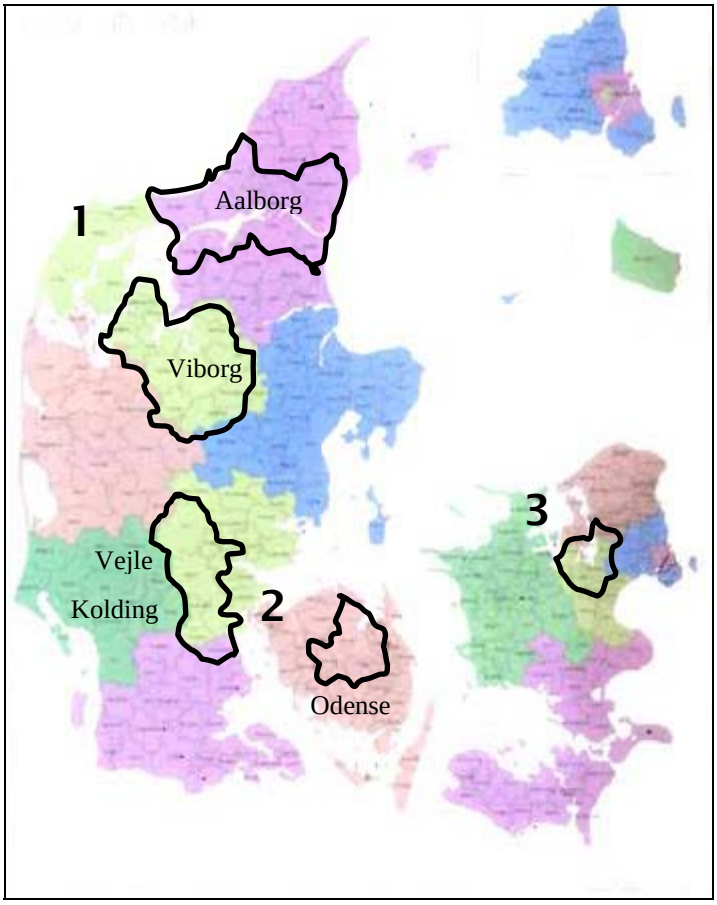

Figure 1. Map of Denmark showing the hospitals in two regions

2.1.3 Distribution of hospitalised drivers

Seriously injured drivers were brought to the hospital from road accidents. Although the hospital catchment areas with regard to population size do not differ much between region 1 and 2, ***table 1*** shows that two thirds of the injured drivers were brought to one of the three hospitals in region 2.

Table 1. Distribution by region, N=852

Region	Number	Percentage
4501 Aalborg and Viborg	269	31.6%
4502 Vejle, Kolding and Odense	583	68.4%

Although the hospitals informed DTU about the size of their catchment areas before the study started, it turned out that victims from road traffic accidents that took place outside the catchment areas of Kolding and Odense hospital were also brought to these hospitals.

2.1.4 Distribution by type of road

Based on information about the accident place, in most cases it was possible to determine whether the accident took place on an urban or rural road. As shown in ***table 2***, most of the accidents of the seriously injured drivers took place on rural roads. For 5% of the drivers, the road type was not known.

Table 2. Distribution of drivers by road type, N=852

Road type	Number of drivers	Percentage of drivers
Urban roads	194	22.8%
Rural roads	615	72.2%
Unknown	43	5.0%

2.1.5 Distribution by type of vehicle

The hospitals were asked to record whether the vehicle was a passenger car or a van. As shown in ***table 3***, the majority of vehicles were passenger cars.

Table 3. Distribution of drivers by road type, N=852

Vehicle type	Number of drivers	Percentage of drivers
Passenger cars	801	94.0%
Vans	42	4.9%
Unknown	9	1.1%

2.1.6 Distribution by type of accident

The hospitals were asked to record whether the accident was a single vehicle accident or a multiple vehicle accident. As shown in ***table 4***, there was an equal distribution between single and multiple vehicle accidents

Table 4. Distribution of single and multiple vehicle accidents, N=852

Accident type	Number of drivers	Percentage of drivers
Single vehicle	419	49.2%
Multiple vehicle	419	49.2%
Unknown	14	1.6%

2.1.7 Distribution of drivers by season

Based on the accident date, the drivers have been grouped by season. As the inclusion period started on 1 October 2007 (1 December 2007 for Aalborg hospital) and ended on 31 March 2010, quarter 1 and 4 cover three years and quarter 2 and 3 only two years. ***Table 5*** shows the mean distribution within each quarter of the year. The lowest number of seriously injured drivers was included in quarter 2 and the highest number in quarter 4.

Table 5. Distribution of drivers by quarter of the year, N=852

Season of the year	Number of drivers	Mean number of drivers per year	Mean percentage of drivers
Quarter 1 January-March	265	88	26.3%
Quarter 2 April-June	140	70	20.9%
Quarter 3 July-September	163	82	24.5%
Quarter 4 October-December	284	95	28.3%

2.1.8 Distribution of drivers by day of the week and time of the day

The day and time of the accidents were grouped into type of day (week day – weekend day) and time of day (day: 4-10, 10-16 and 16-22, night: 22-04), according to the 8 DRUID time periods, as described in Annex 1 of the summary report. As shown in ***table 6***, the majority of the accidents took place during week days, followed by weekend days.

Table 6. Distribution of drivers by time and day of the week (DRUID time periods) , N=852

DRUID time period	Number of drivers	Percentage of drivers
Week day (1-3)	510	59.9%
Week nights (4)	40	4.7%
Weekend days (5-7)	215	25.2%
Weekend nights (8)	69	8.1%
Unknown	18	2.1%

2.1.9 Distribution of drivers by gender and age

The distribution by age and gender is shown in ***table 7.*** The percentages of seriously injured males and females differ slightly, with an underrepresentation of young females aged 18-24 and 25-34 and consequently an overrepresentation of females aged 35 and above.

Table 7. Distribution by gender and age (18-24; 25-34; 35-49 and 50+), N=852

Age group	Number of males	Percentage of males	Number of females	Percentage of females
18-24	193	34.5%	81	27.7%
25-34	144	25.8%	63	21.5%
35-49	129	23.1%	88	30.0%
50+	92	16.4%	56	19.1%
Unknown	1	0.2%	5	1.7%
Total	559	65.6%	293	34.4%

2.2 Methods: Data collection and analysis

2.2.1 Ethical approval

No ethical approval was needed in Denmark. After having been informed about the project, the Ethical Committee answered that "the project is not encompassed by the law on Ethical Committees and consideration regarding bio-medical research projects. Therefore, the project should not be announced to the ethical Committee". Hence, no informed consent was requested.

2.2.2 Specimen collection

5-10 mL whole blood was collected in vacuum tubes containing sodium fluoride and potassium oxalate. For wiping the skin before taking the sample, no alcohol swabs were used. Instead a disinfectant swab with chlorhexidine was used. The vacuum tubes, provided with the ID bar code, were gently mixed 5-10 times immediately after collection to prevent coagulation. The tubes were stored in plastic containers before they were stored in the deep freezer in the laboratory of the hospital.

2.2.3 Tocicological analysis

All drugs except ∆-9-tetrahydrocannabinol
To analyse the blood samples for the European DRUID project an ultra performance liquid chromatography tandem mass spectrometry (UPLC-MS/MS) method was developed and validated for detection of 29 medicine and illicit drugs. The drugs detected were the DRUID core drugs: morphine, 6-acetylmorphine, codeine, amphetamine, methamphetamine, MDA, MDMA, MDEA, methadone, cocaine, benzoylecgonine, zolpidem, diazepam, nordiazepam, clonazepam, flunitrazepam, , oxazepam, alprazolam, lorazepam, zopiclone, and THC-COOH as well as the following extra drugs: tramadol, buprenorphine, nitrazepam, 7-aminonitrazepam, 7-aminoclonazepam, 7-aminoflunitrazepam, bromazepam and chlordiazepoxide.

Solid phase extraction was performed with a Gilson ASPEC XL4 system equipped with Bond Elut Certify SPE sample cartridges. Whole blood samples (200 mg) diluted with 5 ml of ammonium acetate/methanol (v/v, 90:10) buffer were applied to the columns and eluted with 3 ml of acetonitrile containing 0.5% (v/v) aqueous ammonia. Target drugs were quantified using a Waters ACQUITY UPLC system coupled to a Waters Quattro Premier XE triple quadrupole (ESI+, MRM mode). The column used for the chromatography was a 100 mm × 2.1 mm, 1.8 µm Acquity UPLC HSS T3 C18, which was maintained at a column temperature of 35°C and a constant flow rate of 0.4 mL/min. The mobile phase was composed of solvents A (2 mmol/L ammonium acetate, pH 6.2) and B (100% methanol). A chromatographic gradient program was run for 15 min. The injection volume was 10 µL.

Extraction recoveries were 20%–93% for all analytes (***table 8***). Lower limits of quantification (LloQ) was 1.0 µg/L for all analytes; measuring range: 1.0-100 µg/L except morphine and THC-COOH. LloQ for morphine was 10 µg/L; measuring range: 10-100 µg/L. LloQ for THC-COOH was 5 µg/L; measuring range: 5-100 µg/L. Minor to moderate matrix effect was seen but no major ion suppression or enhancement was observed. Total imprecision (CV) of the method was 3-30%.

Table 8. Extraction recovery for the drugs

Analyte	Extraction Recovery (%) (*n*=6)
THC	35
THC-COOH	20
Buprenorphine	54
7-AMN	47
7-AMC	40
7-AMF	44
Bromazepam	35
Zopiclone	81
Nitrazepam	49
Oxazepam	61
Clonazepam	66
Lorazepam	70
Chlordiazepoxide	93
Alprazolam	87
Flunitrazepam	77
Nordiazepam	83
Diazepam	86
Zolpidem	85
Methadone	79
Tramadol	81
6-Acetylmorphine	54
Benzoylecgonine	34
Codeine	62
Cocaine	88
Morphine	20
Amphetamine	50
Methamphetamine	53
MDA	73
MDMA	49
MDEA	70

∆-9-Tetrahydrocannabinol

Whole blood samples (200 mg) were spiked with internal standard (THC-D3) and extracted with pentane. After centrifugation, the organic phase was evaporated at room temperature under a stream of nitrogen and redissolved in 200 µL mobile phase.

The analyses were performed on an Acquity UPLC-Quattro Premier XE Tandem MS/MS system (Waters). The separation column was a Waters Acquity 2.1 x 50 mm, 1.7 micron. The solvent consists of 2 mM ammonium acetate pH 6.2:methanol (9:1) (isocratic). Run time was 3 min.

Extraction recovery was 35%. Lower limit of quantification (LloQ) was 0.2 µg/L; measuring range: 0.2-50 µg/L. Matrix effect and ion suppression/enhancement were not seen. Total imprecision was 7-17%.

2.2.4 Method of BAC quantification

100 µL sample volume (whole blood) was sampled 2 times and analyzed on 2 different Restek columns, length: 30 m and I.D. 0.25 mm. 2-butanol was used as internal standard for the analysis on Restek column-1 and 2-methyl-2-propanol used as internal standard for Restek column-2. The chromatography was done isothermically at 30 ^{0}C. Carrier gas was nitrogen 5.0 . Cut off was 0.1 g/L.

2.2.5 Information about the drivers

The hospitals were asked to record the following information on the patient datasheet:
Patient information

- Identification number (for labeling of samples and recorded data)
- Age and gender
- Time and date of sampling
- Medication/Fluids administered prior to blood sampling
- Severity of injuries (according to Danish trauma scales)

Accident information

- Time and date of the accident
- Place of accident for decision on road type (urban and rural)
- Type of accident (single vehicle or multi vehicle)
- Type of vehicle (passenger car or van)

Based on the information about the time of the accident and the time of blood sampling, drivers whose blood sample was taken more than three hours after the accident were excluded from the study. 12 drivers have been excluded from the study population because of this. These drivers are excluded from the study population in the further analyses. The remaining study population includes 840 seriously injured drivers.

2.3 Non-response/refusals

In those hospitals where it was decided to provide the patients with the information leaflet, patients could refuse participation. A few patient datasheets were returned with this information. But no registration of the patients that refused is available. Nor is any information on drivers that filled in the inclusion criteria, but for some reason, e.g. time pressure, were not included in the study. However, it is unlikely that this has influenced the distribution of drivers in the study population.

2.4 Results

Based on the toxicological analyses of the core substances and various information regarding the patients and the accidents, a number of cross tabulations are shown. The results have been processed by means of SAS computing programmes. The core substances have been grouped into substance groups according to the information in Annex 1 of the summary report. It should however be noted that although tramadol is considered an extra substance, samples that were positive for tramadol are included in

the substance group medicinal opioids. All substance concentrations are above the DRUID cut-off and each positive concentration is only recorded one time in the percentages of positive samples. Samples that are positive for more than one substance are recorded either in the group alcohol-drugs or in the group drug-drug. The percentages are thus mutually exclusive.

The distribution of substance groups by time of the day and day of the week is shown in ***table 9***. Alcohol alone was found in 15.36% of the study population, with a considerably higher prevalence in weekends compared to the working days. The most prevalent drug is medicinal opioids (2.50%), of which the prevalence was considerably higher during weekdays compared to weekends. Combinations of alcohol and drugs or multiple drugs were found in 7.03% of the study population, with a higher prevalence of alcohol in combination with drugs in weekends whereas the highest prevalence of multiple drugs was found in working days. Amphetamine is only found in working days. Finally medicinal opioids are more prevalent during the week than in the weekend.

Table 9. Distribution of substance groups by day of the week (percentages), N=840

	Week (period 1-4) (N=542)	Weekend (period 5-8) (N=280)	Unknown (N=18)	In total (N=840)
Alcohol	10.70	24.64	11.11	15.36
Amphetamines	1.66	0	0	1.07
Benzoylecgonine	0	0	0	0
Cocaine	0	0.18	0	0.12
THCCOOH	1.85	1.43	0	1.67
THC	0.74	0.36	0	0.60
Illicit opiates	0.18	0	0	0.12
Benzodiazepines	1.66	1.43	0	1.55
Z-drugs	0.55	0.36	0	0.48
Medicinal opioids	2.95	1.79	0	2.50
Alcohol-drugs	3.51	6.07	0	4.29
Multiple drugs	3.14	2.14	0	2.74
Total	26.94	38.40	11.11	30.50

Table 10 shows the distribution by time of the day and day of the week. In total, more than half of the seriously injured drivers were positive for one of the substance groups. The highest prevalence of alcohol positive samples is found in weekend nights, followed by week nights whereas the highest prevalence of alcohol in combination with drugs is found in week nights, followed by weekend nights, whereas a higher prevalence of combined alcohol and drug positive samples were found in the study population from accidents that took place during the week nights that the weekend nights.

Besides alcohol and alcohol in combination with drugs that are the most prevalent substance groups both in week nights and weekend nights, week nights are characterised by a high prevalence of amphetamines, cocaine and THCCOOH, whereas weekend nights are characterised by a high prevalence of benzodiazepines. Medicinal opioids were prevailing in week days.

Table 10. Distribution of substance groups by time of the day and day of the week (percentages), N=840

	Week days (N=503)	Week nights (N=39)	Weekend days (N=212)	Weekend nights (N=68)	Unknown (N=18)	In total (N=840)
Alcohol	9.15	30.77	20.75	36.75	11.11	15.36
Amphetamines	1.39	5.13	0	0	0	1.07
Benzoylecgonine	0	0	0	0	0	0
Cocaine	0	2.56	0	0	0	0.12
THCCOOH	1.39	7.69	1.89	0	0	1.67
THC	0.80	0	0.47	0	0	0.60
Illicit opiates	0.20	0	0	0	0	0.12
Benzodiazepines	1.79	0	0.94	2.94	0	1.55
Z-drugs	0.60	0	0.47	0	0	0.48
Medicinal opioids	3.18	0	1.89	1.47	0	2.50
Alcohol-drugs	2.78	12.82	4.72	10.29	0	4.29
Multiple drugs	3.38	0	2.36	1.47	0	2.74
Total	24.86	58.97	33.49	52.89	11.11	30.50

547 men and 293 women were included in the final study population. ***Table 11*** shows the distributions of men and women in the study population by substance group and age. The percentage of positive samples from the seriously injured men amounts to 38.20, whereas the percentage for women is 16.03.

Both for men and women, the highest total prevalence was found in the age group 25-34, and also the highest prevalence of alcohol was found in this age group. Next prevalent for men was alcohol in combination with drugs, again with the highest prevalence in the group aged 25-34.

Among the illicit drugs, THCCOOH was the most prevalent drug group, with equal prevalence in the three age groups of men aged 49 and below. For women, the age group of 25-34 had the highest prevalence of both THC and THCCOOH.

Medicinal opioids were quite prevalent (3.17-5.68%) for men aged 35 and above and for women aged 25 and above, whereas benzodiazepines and z-drugs were most prevalent among men aged 50 and above.

Table 11. Distribution of substance groups for men (N=547) and women (N=293) by age (percentages)

Men						
	18-24 (N=188)	**25-34 (N=141)**	**35-49 (N=127)**	**50+ (N=90)**	**Unknown (N=1)**	**All ages (N=547)**
Alcohol	20.21	26.24	22.05	14.44	0.85	21.39
Amphetamines	1.06	3.55	0	0	0	1.28
Benzoylecgonine	0	0	0	0	0	0
Cocaine	0	0.71	0	0	0	0.18
THCCOOH	2.13	2.13	2.36	1.11	0	2.01
THC	1.60	0	0.79	0	0	0.73
Illicit opiates	0	0	0.79	0	0	0.18
Benzodiazepines	1.06	0.71	1.57	3.33	0	1.46
Z-drugs	0	0	0	2.22	0	0.37
Medicinal opioids	0.53	0.71	3.15	5.56	0	2.00
Alcohol-drugs	5.32	9.93	3.94	3.33	0	5.85
Multiple drugs	2.13	2.84	4.72	1.11	0	2.74
Total	34.04	46.82	39.37	31.10	0.85	38.20
Women						
	18-24 (N=81)	**25-34 (N=63)**	**35-49 (N=88)**	**50+ (N=56)**	**Unknown (N=5)**	**All ages (N=293)**
Alcohol	1.23	7.94	2.27	7.14	0	4.10
Amphetamines	2.47	0	0	0	0	0.68
Benzoylecgonine	0	0	0	0	0	0
Cocaine	0	0	0	0	0	0
THCCOOH	1.23	1.59	1.14	0	0	1.02
THC	0	1.59	0	0	0	0.34
Illicit opiates	0	0	0	0	0	0
Benzodiazepines	1.23	1.59	1.14	1.79	20.00	1.70
Z-drugs	0	1.59	0	1.79	0	0.68
Medicinal opioids	0	3.17	5.68	3.57	20.00	3.41
Alcohol-drugs	0	1.59	2.27	1.79	0	1.37
Multiple drugs	1.23	4.76	2.27	3.57	0	2.73
Total	7.39	23.82	14.77	19.65	40.00	16.03

The number of accident was equally distributed between single vehicle accidents and multiple vehicle accidents.

Table 12 shows that the prevalence of alcohol is more than four times higher in single vehicle accidents than in multiple vehicle accidents. However, this trend is not found for the other drugs, except for alcohol combined with drugs and multiple drug use.

Table 12. Distribution of substance groups by accident type (percentages), N=840

	Single vehicle (N=411)	Multiple vehicle (N=415)	Unknown (N=14)	In total (N=840)
Alcohol	24.33	6.02	28.57	15.36
Amphetamines	1.22	0.96	0	1.07
Benzoylecgonine	0	0	0	0
Cocaine	0.24	0	0	0.12
THCCOOH	1.46	1.69	7.14	1.67
THC	0.49	0.72	0	0.60
Illicit opiates	0.24	0	0	0.12
Benzodiazepines	1.46	1.69	0	1.55
Z-drugs	0.49	0.48	0	0.48
Medicinal opioids	2.19	2.89	0	2.50
Alcohol-drugs	5.84	2.65	7.14	4.29
Multiple drugs	3.65	1.93	0	2.74
Total	41.61	19.03	42.85	30.50

The following table **(*table 13*)** shows the number of positive samples for the additional substances that were analysed for in Denmark and that were included in the results for the core drugs. ***Table 14*** shows the results for the other four extra substances included in the toxicological analyses in Denmark.

Table 13. Distribution of additional substances included in the substance groups at or above the DRUID cut-off

Substance	Number of samples above the cut-off
Tramadol	18
7-amino clonazepam	22
7-amino flunitrazepam	7
Total	47

Table 14. Distribution of other additional substances at or above the DRUID cut-off

Substance	Number of samples above the cut-off
Buprenorphine	2
Bromazepam	2
Chlordiazepoxide	7
Nitrazepam	8
7-amino nitrazepam	6
Total	19

Finally, ***table 15*** shows the concentration distribution of the core substances, including tramadol, 7-amino clonazepam and 7-amino flunitrazepam and ***table 16*** shows the concentration distribution of the other additional substances that were analysed for in Denmark.

Compared to the DRUID cut-offs, the medians for all substances are far above this value.

Table 15. Concentration distribution of core substances, including three additional substances. Only concentrations at and above the DRUID cut-offs

Substance	Number of cases	Concentration range (ng/mL)		Median (ng/mL)	Mean (ng/mL)
		Min	Max		
Ethanol	165	0.12 g/L	3.18 g/L	1.52	1.50
Morphine	6	12.30	275.70	57.40	97.45
Amphetamine	31	22.00	1095.00	99.70	179.63
MDMA	1	47.60	47.60	47.60	47.60
MDA	0	n.a.	n.a.	n.a.	n.a.
Cocaine	5	11.60	28.90	24.60	22.86
THC	11	1.20	6.65	2.66	3.19
Diazepam	21	22.10	1747.00	177.00	311.05
Alprazolam	2	19.50	128.50	74.00	74.00
Clonazepam	23	11.20	174.00	39.10	46.96
Benzoylecgonine	11	51.60	1329.00	257.70	459.44
Codeine	7	10.60	66.90	38.30	42.35
6-acetylmorphine	1	12.40	12.40	12.40	12.40
Metamphetamine	8	22.20	227.70	41.40	86.15
Methadone	9	34.80	581.00	317.40	300.96
Oxazepam	9	119.20	467.90	228.90	272.42
Nordiazepam	22	54.30	854.90	258.45	323.30
Zolpidem	4	50.60	1161.00	104.40	355.10
MDEA	0	n.a.	n.a.	n.a.	n.a.
THC-COOH	53	5.50	351.00	40.90	59.70
Lorazepam	0	n.a.	n.a.	n.a.	n.a.
Flunitrazepam	3	6.10	12.10	9.92	9.37
Zopiclone	6	19.60	422.00	74.06	122.82
7-a-clonazepam	22	14.80	146.80	46.40	53.65
7-a-flunitrazepam	7	2.60	69.60	8.20	21.39
Tramadol	18	55.70	4376.00	133.05	489.13

Table 16. Concentration distribution of additional substances. Only concentrations at and above the DRUID cut-offs

Substance	Number of cases	Concentration range (ng/mL)		Median (ng/mL)	Mean (ng/mL)
		Min	Max		
Buprenorphine	2	1.00	1.30	1.15	1.15
Bromazepam	2	30.80	78.30	54.55	54.55
Chlordiazepoxide	7	43.50	3119.00	377.00	1032.63
Nitrazepam	8	14.50	231.30	38.65	60.54
7-amino nitrazepam	6	12.00	116.00	32.45	42.58

2.5 Discussion of results

2.5.1 Distribution of the study sample

Compared to the distribution of accidents with seriously injured drivers of passenger cars and vans in the accident statistics, the distribution of the study sample by urban and rural roads is very close the official accident statistics. In the study sample, 22.8% were women, 72.2% were men and for 5% the gender was not known. Based on the mean of

the years 2001-2009, 29% of the drivers were seriously injured in accidents on urban roads whereas 71% were injured in accidents in rural roads.

As for the distribution of men and women in the study sample this is 65.6% men and 34.4% women whereas the distribution in the official statistics is 60% men and 40% women. The distribution by age is also close the distribution in the official accident statistics.

Regarding alcohol the official accidents statistics reveal that 85% of the seriously injured drivers of passenger cars or vans with an illegal alcohol limit (>= 0.05% in Denmark) were men and 15% were women. This is very close to the situation in the study sample where 149 men (27.24% of 547) were positive for alcohol alone or in combination with drugs (>0.01%) whereas 16 women (5.47% of 293) were positive. This means that 90% of the alcohol positive samples were from men and 10% were from women. Taken into account that the results from the study population include alcohol concentrations above 0.01%, this seems to be comparable with the official accident statistics.

2.5.2 Non-response

The information on drivers who refused to take part in the study or were not included because of time pressure is sparse. However, it is assumed that non-response is randomly distributed during the study period.

The only biased non-response period was May 2009 where there was a strike among nurses. We got the information that the strike had influenced the data collection in this period, but only in one of the hospitals.

2.5.3 Important results

Time of the week and the day
Alcohol is the most prevalent drug in the study population (15.36% of the samples were positive for alcohol alone and 4.29% for alcohol in combination with other drugs). The prevalence is more than twice as high in weekends than during working days. Furthermore, the prevalence in the day time is twice as high in weekend days than week days whereas the difference is not so big between nighttime of the working days and the weekend.

Single medicines and illicit drugs are more prevalent in the study population of seriously injured drivers during working days than in weekend days. This is also the case multiple drug combinations whereas alcohol in combination with other drugs is found mostly during nights of both parts of the week.

Benzoylecgonine was only found in combination with alcohol and other drugs.

THCCOOH was found both alone and in combination with alcohol and other drugs. However, only those samples where it was found alone are included in the percentages. This is due to the rule of mutually exclusivity which means that a positive sample can only be registered in one category and because alcohol in combination with THCCOOH is not considered an alcohol-drug combination. Combinations of alcohol and drugs or drug combinations were found in 7.03% of the samples.

For some of the single drugs, that is alcohol, amphetamines, cocaine and THCCOOH the prevalence is higher during night than during daytime. The opposite is the case for THC, illicit opiates, z-drugs and medicinal opioids.

Age and gender
The prevalence of alcohol and alcohol in combination with drugs is more than five times as high for men than for women in the study population of seriously injured drivers. Regarding illicit drugs, it is also higher for men than for women: Amphetamines, THCCOOH and THC for men is about two times the prevalence for women.

But regarding medicinal drugs, the prevalence for women in the study population of seriously injured drivers is higher than for men: This is the case for benzodiazepines, z-drugs and medicinal opioids.

Type of accident
There is a big difference in the study population regarding prevalence of alcohol for drivers in single and multiple vehicle accidents, where the alcohol prevalence is four times as high in single vehicle accidents as in multiple vehicle accidents. For medicinal and illicit drugs this tendency is only found for amphetamines, alcohol-drug combinations and multiple drug combinations.

2.6 Acknowledgement

This study could not have been carried out without the help of the personnel in Aalborg, Viborg, Vejle, Kolding and Odense hospital. Both the personnel in the emergency rooms and the laboratory technicians have contributed to the finalisation of the study.

3 Country Report Finland

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3.1 Description of the hospitalised driver sample

3.1.1 Introduction

The aim of the survey was to make an estimate of alcohol and drug use among drivers injured in traffic accidents and also to evaluate the relative risk for accident involvement while impaired by psychoactive substances using data collected in the roadside survey (Task 2.3). The samples and survey participant information were collected in southern Finland at two hospitals whose catchment areas covered the counties of Uusimaa and Itä-Uusimaa. About 28% of the Finnish population lives within this area. According to national statistics (1), 8513 people were injured in traffic accidents in 2008 and of these injuries 26% occurred within the catchment areas.
The survey was conducted in accordance with the guidelines for the hospital survey (see Annex 1 of the Summary Report).

Sample collection and interviews were carried out at the hospitals by nurses, who then sent the samples and interview forms to National Institute for Health and Welfare (THL), where the toxicological analyses were performed. 325 drivers were included in the survey. A total of 633 samples was collected, consisting of 322 whole blood samples and 311 oral fluid (OF) samples. Patients included in the study were drivers of a motor vehicle or a bicycle. To ensure efficient recruiting of patients and a high inclusion rate, all injured drivers over 18 years old, even if only slightly injured, were asked to participate. The severity of the injuries was determined afterwards from hospital patient data, which led to patients with less severe injuries to also be included in the database. In addition the time between the accident and sampling was only determined later by the research team at THL, thus cases with a time difference of over three hours between the accident and sampling were included as well.

Police traffic accident statistics for all Finland concerning type of vehicle and month of accident for injured drivers were available from 2008, so a limited comparison of the survey data to national data were possible.

3.1.2 Geographical distribution of hospitalised drivers over the country

The hospital survey was started at one hospital (Jorvi hospital, Espoo), but it was noticed that the patients brought to this hospital had only minor injuries. Therefore a bigger hospital (Töölö trauma centre, Helsinki) with more severely injured patients was included in the survey and sample collection at Jorvi hospital ceased. The catchment area of the two hospitals is shown in Figure 1.

Figure 1. Map of Finland. The catchment area of the hospitals is marked in red.

3.1.3 Distribution of hospitalised drivers

The road type at the site of the accident was recorded during the interview as urban or rural. The distribution of injured drivers according to road type is shown in table 1. Road type information was missing in 15 cases. The study population is quite evenly distributed between the two road types.

Table 1. Distribution of injured drivers by road type.

Road type	Fraction of injured drivers (N = 310)
Urban	0.426
Rural	0.574
Total	1

The severity of the injuries was determined afterwards from the patient data by a physician. The Maximum Abbreviated Injury Scale (MAIS) was used to measure the severity of injuries. The distribution of drivers by MAIS is shown in Table 2. The MAIS value was missing in 8 cases.

Table 2. Distribution of injured drivers by injury severity (MAIS).

MAIS	Fraction of injured drivers (N = 317)
0	0.035
1	0.467
2	0.306
3	0.170
4	0.019
5	0.003
Total	1

Injured drivers were recruited between 26 April 2008 and 30 April 2010. The distribution of drivers by season (quarter of year) is shown in Table 3. For comparison, the quarterly distribution of injured drivers in 2008 in Finland according to national statistics is also presented. In both populations the fraction of drivers during the 2nd and 3rd quarters is slightly higher than during the 1st and 4th quarters.

Table 3. Distribution of injured drivers by season.

Quarter of the year	Fraction of injured drivers in the survey	Fraction of injured drivers based on national statistics*
First (Jan, Feb, Mar)	0.114	0.161
Second (Apr, May, Jun)	0.348	0.281
Third (Jul, Aug, Sep)	0.350	0.325
Fourth (Oct, Nov, Dec)	0.188	0.233
Total	1	1

* 2008 Finnish national traffic accident statistics based on accidents reported to the police (1)

The exact time of accident was recorded in order to enable the division of the drivers into eight DRUID time codes, as proposed in the D 2.1.2 guidelines for hospital surveys. The distribution of drivers by day of the week and time of the day is shown in Table 4 The fraction of injured drivers is smaller during night time (22:00 to 04:00) than during the day for both weekdays and weekends. This is probably due to the volume of traffic flow which is also smaller during night (Task 2.2a).According to national statistics (1), in 2008 only 11.4% of all injuries in traffic accidents occurred during night hours.

Table 4. Distribution of injured drivers by day of the week and time of the day.

DRUID time code	Fraction of injured drivers
Weekday 4:00 to 10:00	0.160
Weekday 10:00-16:00	0.200
Weekday 16:00-22:00	0.154
Weekday 22:00-4:00	0.077
Weekend 4:00-10:00	0.074
Weekend 10:00-16:00	0.095
Weekend 16:00-22:00	0.145
Weekend 22:00-4:00	0.095
Total	1

The total number of cases was 325. Age and gender were recorded for all injured drivers, and they were divided into four age groups according to the guidelines for the survey. Table 5 shows the distribution of drivers by age group and gender. National statistics show that the gender distribution of people injured in traffic accidents in 2008 was 57% male and 43% female (1), thus it appears that in our study population males are overrepresented (77%). Comparison of age of the study population with national statistics was not possible since the age brackets in the two datasets were different.

Table 5. Distribution of injured drivers by age and gender.

	Fraction of injured drivers		
Age group (years)	Male	Female	In total
18-24	0.185	0.049	0.234
25-34	0.206	0.049	0.255
35-49	0.209	0.062	0.271
50+	0.172	0.068	0.240
Total	0.772	0.228	1

The distribution of drivers according to age and gender is also shown in Figure 2.

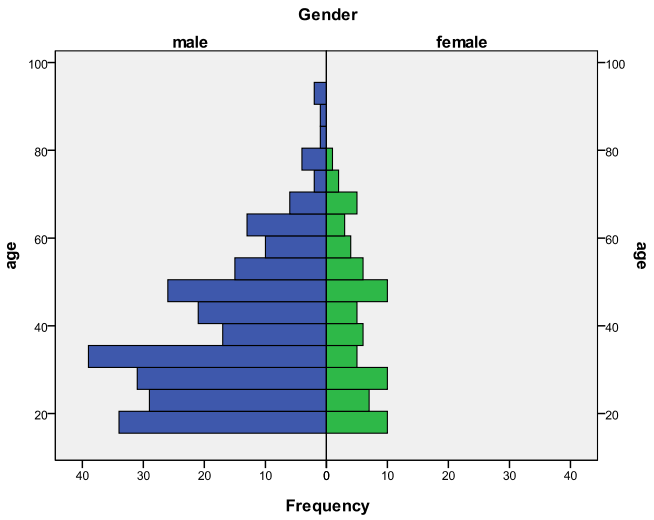

Figure 2. Age and gender distribution of injured drivers.

The type of the vehicle was also recorded. The distribution of injured drivers by type of vehicle is shown in Table 6. Most of the patients were drivers of passenger cars (61.7%) but motorcyclists (19.4%) and bicyclists (10.5%) also constituted a large fraction of the injured drivers. The 'other' vehicles included in the survey were quad bikes and a snowmobile. National traffic accident statistics from the year 2008 are also shown in Table 6 for comparison. Motorcycles seem to be overrepresented in our survey population whereas vans and bicycles are somewhat underrepresented.

Table 6. Distribution of injured drivers by vehicle.

Type of vehicle	Fraction of injured drivers in the survey	Fraction of injured drivers based on national statistics*
Car	0.617	0.620
Van	0.025	0.054
Truck/bus	0.028	0.035
Motorcycle	0.194	0.089
Bicycle	0.105	0.162
Moped	0.022	0.025
Other	0.009	0.015
Total	1	1

* 2008 Finnish national traffic accident statistics based on accidents reported to the police (1)

The distribution of single and multiple vehicle accidents is shown in table 7. This information was missing in 6 cases.

Table 7. Distribution of drivers by type of accident.

Type of accident	Fraction of injured drivers (N = 319)
Single vehicle	0.533
Multiple vehicle	0.467
Total	1

3.2 Methods: Data collection and analysis

3.2.1 Ethical approval

The research survey plan was approved by the coordinating ethical advisory board of the Hospital District of Helsinki and Uusimaa. Signed informed consent was necessary for all respondents. The identity of the drivers was not recorded.

3.2.2 Specimen collection

After informed consent was given, the interview was performed by a nurse from the hospital who also took the samples. The majority of the cases, 319 out of 325, were recruited at Töölö trauma centre and the rest at Jorvi hospital. Sample matrices collected were whole blood (N=322) and/or OF (N=311), both matrices were collected from 308 patients. Altogether 633 samples were collected. OF samples were collected with the StatSure SalivaSampler™ device (StatSure Diagnostic Systems, Inc., NY, USA) and the samples were stored at -18 ºC. Whole blood samples were collected in 10 ml evacuated Venoject® glass tubes (Terumo corp., Japan) containing sodium fluoride and potassium oxalate as stabiliser and anticoagulant, respectively. Blood samples were stored at + 4 ºC before analysis. In some cases the injured drivers were sampled at the hospital for external reasons and if there was sample left after the analysis performed at the hospital, the rest of the sample was sent to the THL laboratory in the original tube. The analyses at THL were then performed from this sample. All results presented in this report are from blood samples.

3.2.3 Toxicological analysis of body fluids

All samples from injured drivers were analysed at the drug analytics laboratory of THL by gas chromatography-mass spectrometry (GC-MS) methods. Analysis methods and validation results are presented in (2) and (3). The methods are in continuous routine use in the laboratory for prison, hospital and drug driving samples. Analytes were extracted from the samples using either solid phase extraction (SPE) or liquid-liquid extraction (LLE) and the mass selective detector (MSD) was working in either electron ionisation (EI) or negative chemical ionisation (NCI) mode, depending on the method. The cut-offs applied for positive results are listed in the Methods section of the Summary Report.

3.2.4 Method of BAC quantification

Blood alcohol concentration in g(ethanol)/l(blood) (‰) was determined from the whole blood samples with a headspace-gas chromatography method (4) at THL.

3.2.5 Other collected data

The following data were requested in the interview form:
Gender

- Birth year
- Year first motor vehicle licence achieved
- Is the driver currently in possession of a valid licence?
- Is the driver a professional driver?
- Type of vehicle
- Annual mileage
- Time of blood sample (if the sample was a hospital diagnostic sample: type of the tube)
- Time of oral fluid sample
- Ordinary sampling time (i.e. within 5 mins), all deviations recorded
- Time and place of accident

- Road type
- Single or multiple vehicle accident

3.2.6 Statistical analysis

The data were processed with PASW (Predictive Analytics SoftWare) Statistics 17.0 by SPSS: An IBM® Company.

3.3 Non-response, refusals

3.3.1 Size and nature of non-response

The overall participation rate was 82.9% (325 injured drivers participated from 392 potential cases). A number of drivers did not refuse to participate in the survey, but were then excluded, e.g. the driver was under 18 or was moved to another hospital before the interview could be completed. Therefore, the actual consent rate of eligible participants is 91.5% (30 non-respondents out of 355 eligible surveyed drivers).

3.3.2 Possible confounding effect of non-response

Since the consent rate in the survey is more than 90%, it is safe to assume that non-response does not have any confounding effect on the results.

3.4 Results

From the 325 injured drivers and cyclists included in the survey there were 93 cases (28.6%) with positive findings, above LOQ, for DRUID core substances. This increases to 101 (31.1%) if additional substances analysed in Finland are included.

Nationally, the highest prevalence was for alcohol with 21.5% (70 cases) of alcohol positive cases. 15.7% (51 cases) of all participants had blood alcohol concentrations of 1.3 g/L or more, 3.1% (10 cases) between 0.8 and 1.3 g/L, 1.2% (4 cases) between 0.5 and 0.8 g/L and 1.5% (5 cases) between 0.1 and 0.5 g/L.

The prevalence of other substance classes was 9.8% for benzodiazepines and Z-drugs (32 cases: 28 with benzodiazepines only, 3 with Z-drugs only and 1 with both), 2.5% (8 cases) for THC, 2.2% (7 cases) for opioids (either illicit or medicinal) and 1.8% (6 cases) for amphetamines.

3.4.1 Detailed substance group distribution for the area the results are applicable to

Table 8 shows the distribution of cases by substance groups in Uusimaa region where all samples were collected.

Table 8. Regional distribution of number of cases by substance groups detected.

Substances present	Uusimaa N (%)
None	232
Amphetamines and THC-COOH	1 (0.3)
THC* only	1 (0.3)
Benzodiazepines only	7 (2.1)
Amphetamines and benzodiazepines	2 (0.6)
THC-COOH and benzodiazepines	3 (0.9)
THC* and benzodiazepines	1 (0.3)
Amphetamines, THC* and benzodiazepines	1 (0.3)
Z-drugs only	1 (0.3)
Benzodiazepines and Z-drugs	1 (0.3)
Opioids** only	4 (1.2)
Benzodiazepines, opioids** and amphetamines	1 (0.3)
Alcohol only	51 (15.7)
THC* and alcohol	3 (0.9)
Benzodiazepines and alcohol	9 (2.8)
Amphetamines, benzodiazepines and alcohol	1 (0.3)
THC, benzodiazepines and alcohol	2 (0.6)
Z-drugs and alcohol	2 (0.6)
Opioids** and alcohol	1 (0.3)
Benzodiazepines, opioids** and alcohol	1 (0.3)
Total	325

*with or without THC-COOH**medicinal or illicit

3.4.2 Distribution of substance groups by DRUID time periods aggregated into day vs night, week vs WE

The distribution of injured drivers according to substance groups and time of the accident (whether it happened during day, 4:00 – 22:00, or night, 22:00 – 04:00) is shown in table 9. 82.8% (269) of the accidents occurred during day and 17.2% (56) during nighttime. The percentage of cases that were negative for all DRUID core substances was 77.0% during day and 44.6% during night, thus there were more positive cases during the nighttime. The distribution of illicit drugs among the positive cases was similar during day and night, with 17.7% of all drug positive cases containing illicit drugs during daytime and 16.1% at night. The percentage of alcohol positive cases was much higher at night (50.0%) than at day (15.6%). Benzodiazepines and/or Z-drugs were found in 8.9% of the cases during day and in 12.5% of the cases during night.

Table 9. Distribution by number of cases according to substance groups detected and time of day.

Substances present	Day N (%)	Night N (%)
None	207 (77.0)	25 (44.6)
Amphetamines and THC-COOH	1 (0.4)	0 (0)
THC* only	0 (0)	1 (1.8)
Benzodiazepines only	6 (2.2)	1 (1.8)
Amphetamines and benzodiazepines	1 (0.4)	1 (1.8)
THC-COOH and benzodiazepines	3 (1.1)	0 (0)
THC* and benzodiazepines	1 (0.4)	0 (0)
Amphetamines, THC* and benzodiazepines	1 (0.4)	0 (0)
Z-drugs only	1 (0.4)	0 (0)
Benzodiazepines and Z-drugs	1 (0.4)	0 (0)
Opioids** only	4 (1.5)	0 (0)
Benzodiazepines, opioids** and amphetamines	1 (0.4)	0 (0)
Alcohol only	30 (11.2)	21 (37.5)
THC* and alcohol	1 (0.4)	2 (3.6)
Benzodiazepines and alcohol	7 (2.6)	2 (3.6)
Amphetamines, benzodiazepines and alcohol	1 (0.4)	0 (0)
THC*, benzodiazepines and alcohol	1 (0.4)	1 (1.8)
Z-drugs and alcohol	1 (0.4)	1 (1.8)
Opioids** and alcohol	1 (0.4)	0 (0)
Benzodiazepines, opioids** and alcohol	0 (0)	1 (1.8)
Total	269 (100)	56 (100)

*with or without THC-COOH **medicinal or illicit

Table 10 shows the distribution of cases by substance groups between week and weekend. 59.1% (192) of the accidents occurred during weekdays and 40.9% (133) during weekends. The proportion of positive cases during weekends (39.1%) was almost double that during the week (21.4%). Most of the cases were positive for alcohol with a prevalence of 15.1% during the week and 30.8% during the weekend. Illicit drugs were found in 8 cases during both week and weekend. This is 19.5% of all positive cases at week and 15.4% at weekend.

Table 10. Distribution by number of cases according to substance groups detected and time of week.

Substances present	Week N (%)	Weekend N (%)
None	151 (78.6)	81 (60.9)
Amphetamines and THC-COOH	1 (0.5)	0 (0)
THC* only	1 (0.5)	0 (0)
Benzodiazepines only	2 (1.0)	5 (3.8)
Amphetamines and benzodiazepines	0 (0)	2 (1.5)
THC-COOH and benzodiazepines	2 (1.0)	1 (0.8)
THC* and benzodiazepines	1 (0.5)	0 (0)
Amphetamines, THC* and benzodiazepines	1 (0.5)	0 (0)
Z-drugs only	0 (0)	1 (0.8)
Benzodiazepines and Z-drugs	0 (0)	1 (0.8)
Opioids** only	4 (2.1)	0 (0)
Benzodiazepines, opioids** and amphetamines	0 (0)	1 (0.8)
Alcohol only	19 (9.9)	32 (24.1)
THC* and alcohol	1 (0.5)	2 (1.5)
Benzodiazepines and alcohol	5 (2.6)	4 (3.0)
Amphetamines, benzodiazepines and alcohol	1 (0.5)	0 (0)
THC*, benzodiazepines and alcohol	0 (0)	2 (1.5)
Z-drugs and alcohol	1 (0.5)	1 (0.8)
Opioids** and alcohol	1 (0.5)	0 (0)
Benzodiazepines, opioids** and alcohol	1 (0.5)	0 (0)
Total	192 (100)	133 (100)

*with or without THC-COOH **medicinal or illicit

3.4.3 Distribution of substance groups by gender and age

Table 11 shows the distribution of cases according to substance groups, age and gender. The majority of the drivers included in the survey were men. The number of drug or alcohol positive cases among women is low, with only 15 positive cases versus 78 positive cases among men. The positive cases among women were mainly single substance use of alcohol, benzodiazepines or opioids, but there were also two cases with combination of alcohol and benzodiazepines. The occurrence of alcohol was higher in younger women whereas older women had higher occurrence of benzodiazepines and opioids. Among young male drivers (18–24 years) alcohol with no other substances was the most common finding. In the 18–24-year-old male group there were three cases positive for cannabis (THC and/or THC-COOH) of which two were also positive for benzodiazepines. In the age group 25–34 years, a combination of substances was more common, especially alcohol combined with illicit drugs and/or medicines. Illicit drugs were also detected among 35–49-year-old men, but in this group the number of cases with alcohol in combination with other substances was lower than among younger men (i.e. below 35 years old). The use of benzodiazepines and Z-drugs was more common among older (50+ years) than younger men.

Table 11. Distribution by number of cases according to substance groups detected and age and gender.

Gender	Substances present	Age group			
		18-24 N (%)	25-34 N (%)	35-49 N (%)	50+ N (%)
Male	None	38	47	43	45
	Amphetamines and THC-COOH	0 (0)	0 (0)	1 (1.5)	0 (0)
	THC* only	1 (1.7)	0 (0)	0 (0)	0 (0)
	Benzodiazepines only	0 (0)	2 (3.0)	1 (1.5)	1 (1.8)
	Amphetamines and benzodiazepines	0 (0)	1 (1.5)	1 (1.5)	0 (0)
	THC-COOH and benzodiazepines	1 (1.7)	1 (1.5)	1 (1.5)	0 (0)
	THC* and benzodiazepines	1 (1.7)	0 (0)	0 (0)	0 (0)
	Amphetamines, THC and benzodiazepines	0 (0)	1 (1.5)	0 (0)	0 (0)
	Z-drugs only	0 (0)	0 (0)	0 (0)	1 (1.8)
	Benzodiazepines and Z-drugs	0 (0)	0 (0)	0 (0)	1 (1.8)
	Opioids** only	0 (0)	1 (1.5)	1 (1.5)	0 (0)
	Benzodiazepines, opioids** and	0 (0)	0 (0)	1 (1.5)	0 (0)
	Alcohol only	19	6 (8.9)	15	3 (5.3)
	THC* and alcohol	0 (0)	1 (1.5)	1 (1.5)	1 (1.8)
	Benzodiazepines and alcohol	0 (0)	2 (3.0)	2 (2.9)	3 (5.3)
	Amphetamines, benzodiazepines and	0 (0)	1 (1.5)	0 (0)	0 (0)
	THC*, benzodiazepines and alcohol	0 (0)	2 (3.0)	0 (0)	0 (0)
	Z-drugs and alcohol	0 (0)	2 (3.0)	0 (0)	0 (0)
	Opioids** and alcohol	0 (0)	0 (0)	0 (0)	1 (1.8)
	Benzodiazepines, opioids** and alcohol	0 (0)	0 (0)	1 (1.5)	0 (0)
Total		60 (100)	67 (100)	68 (100)	56 (100)
Female	None	11	13	17	18
	Benzodiazepines only	0 (0)	0 (0)	1 (5.0)	2 (9.1)
	Opioids** only	0 (0)	0 (0)	0 (0)	2 (9.1)
	Alcohol only	5 (31.2)	2 (12.5)	1 (5.0)	0 (0)
	Benzodiazepines and alcohol	0 (0)	1 (6.2)	1 (5.0)	0 (0)
Total		16 (100)	16 (100)	20 (100)	22 (100)

*with or without THC-COOH **medicinal or illicit

3.4.4 Distribution of substance groups by single-vehicle accidents vs. multiple vehicles

The number of single vehicle accidents in the study was approximately the same as the number of multiple vehicle accidents, but as table 12 shows, the number of positive findings was much higher in single vehicle accidents. Alcohol was the most prevalent substance in both types of accidents. The occurrence of alcohol positive cases (both alcohol only and in combination with other substances) was 34.7% in single vehicle accidents compared to 6.7% of multiple vehicle accidents. In 27.1% of alcohol positive cases involved in single vehicle accidents there was also indication of other substance use.

Table 12. Distribution by number of cases according to substance groups detected and type of accident.

Substances present	Single vehicle N (%)	Multiple vehicle N (%)	Unknown N (%)
None	97 (57.1)	131 (87.9)	4 (66.7)
Amphetamines and THC-COOH	1 (0.6)	0 (0)	-
THC* only	1 (0.6)	0 (0)	-
Benzodiazepines only	3 (1.8)	4 (2.7)	-
Amphetamines and benzodiazepines	1 (0.6)	0 (0)	1 (16.7)
THC-COOH and benzodiazepines	1 (0.6)	2 (1.3)	-
THC* and benzodiazepines	1 (0.6)	0 (0)	-
Amphetamines, THC* and	1 (0.6)	0 (0)	-
Z-drugs only	1 (0.6)	0 (0)	-
Benzodiazepines and Z-drugs	1 (0.6)	0 (0)	-
Opioids** only	2 (1.2)	2 (1.3)	-
Benzodiazepines, opioids** and	1 (0.6)	0 (0)	-
Alcohol only	43 (25.3)	8 (5.4)	-
THC* and alcohol	3 (1.8)	0 (0)	-
Benzodiazepines and alcohol	7 (4.1)	1 (0.8)	1 (16.7)
Amphetamines, benzodiazepines and	1 (0.6)	0 (0)	-
THC*, benzodiazepines and alcohol	2 (1.2)	0 (0)	-
Z-drugs and alcohol	1 (0.6)	1 (0.8)	-
Opioids** and alcohol	1 (0.6)	0 (0)	-
Benzodiazepines, opioids** and alcohol	1 (0.6)	0 (0)	-
Total	170 (100)	149 (100)	6 (100)

*with or without THC-COOH **medicinal or illicit

3.4.5 Distribution of additional substances

In Finland a number of substances were analysed in addition to the DRUID core substance list. There were 31 cases with positive findings of additional substances which were buprenorphine, carbamazepine, amitriptylene, citaprolam, fluoxetine, mirtazapine, and benzodiazepines temazepam, chlordiazepoxide, alpha-OH-midazolam and alpha-OH-alprazolam. The distribution of DRUID core substance groups in cases that were positive for the additional substances is shown in table 13. None of the DRUID core substances were found in 8 of the cases that were positive for additional substances. The findings of these 'negative' cases are shown in table 14.

Table 13. Distribution of cases with additional substance findings according to DRUID substance groups.

DRUID substances present	Additional substances	No. of cases
None	See Table 14	8
Benzodiazepines only	Benzodiazepines, citalopram	4
THC-COOH and benzodiazepines	Benzodiazepines, buprenorphine,	3
Amphetamines, THC* and	Benzodiazepines	1
Z-drugs only	Fluoxetine	1
Amphetamines, benzodiazepines and	Benzodiazepines	1
Alcohol only	Citalopram	5
Benzodiazepines and alcohol	Amitriptyline, carbamazepine,	4
Amphetamines, benzodiazepines and	Benzodiazepines	1
THC*, benzodiazepines and alcohol	Citalopram	1
Opioids** and alcohol	Benzodiazepines	1
Benzodiazepines, Z-drugs, opioids**	Benzodiazepines, mirtazapine	1

* with or without THC-COOH **medicinal or illicit

Table 14. Positive findings of additional substances in cases where no DRUID core substances were present.

Substances present	No. of cases
Chlordiazepoxide	1
Temazepam and citalopram	1
Citalopram	3
Amitriptylene	1
Carbamazepine	1
Temazepam	1

The distribution of cases according to time of day and time of week is shown in table 15 and table 16. The distribution of cases between week and weekend is quite even, but majority of these accidents have occurred during daytime (04:00-22:00).

Table 15. Distribution by number of additional substance cases according to time of day.

	Day	Night	Total
N cases (%)	27 (87.1)	4 (12.9)	31 (100)

Table 16. Distribution by number of additional substance cases according to time of week.

	Weekday	Weekend	Total
N cases (%)	16 (51.6)	15 (48.4)	31 (100)

Table 17 shows the distribution of cases by age and gender. These distributions are similar to those of DRUID core substances. When the cases are distributed according to type of accident (table 18), we can see that 61.3% of them are single vehicle accidents. For comparison, the corresponding number for DRUID core substance positive cases is 80.2%.

Table 17. Distribution by number of additional substance cases according to age and gender.

Gender		Age group				Total
		18–24	25–34	35–49	50+	
Male	N cases (%)	4 (15.4)	8 (30.8)	8 (30.8)	6 (23.0)	26 (100)
Female	N cases (%)	1 (20.0)	1 (20.0)	1 (20.0)	2 (40.0)	5 (100)

Table 18. Distribution by number of additional substance cases according to type of accident.

	Type of accident			Total
	Single vehicle	Multiple vehicle	Unknown	
N cases (%)	19 (61.3)	11 (35.5)	1 (3.2)	31

3.4.6 Distribution of substance concentrations

The range of concentrations encountered for each drug found and, where applicable, median concentration, are shown in table 19 for core DRUID substances and in table 20 for additional substances. Positive concentrations of medicines administered before the sample was taken were also found for morphine (8) and tramadol (4).

Table 19. Distribution of substance concentrations – DRUID core substances.

Analyte	N*	Concentration range (ng/mL)	Median concentration (ng/mL)
Ethanol	70	0.103 – 3.514 g/L	1.623 g/L
Amphetamine	6 (2)	140 – 787	342
THC	8	1.1 – 9.5	2.7
THCCOOH	11	8.2 – 36	23
Diazepam	15	28 – 1012	115
Nordiazepam	16	29 – 1137	118
Oxazepam	11	26 – 1957	59
Alprazolam	10	9.6 - 170	29
Clonazepam	4 (3)	6.1 – 41	18
Zopiclone	3 (4)	11 – 82	12
Zolpidem	1	45	-
Morphine	3 (1)	1.5 – 4.4	3.6
Codeine	6 (1)	5.3 – 217	16
Tramadol	3	87 – 430	96
Methadone	1	51	-

*Number of positive cases above LOQ, number in parentheses are positive cases between LOD and LOQ

Table 20. Distribution of substance concentrations – additional substances in Finland.

Analyte	N*	Concentration range (ng/mL)	Median concentration (ng/mL)
Temazepam	10	31 - 1079	55
Buprenorphine	1	1.2	-
Carbamazepine	2	3285, 7210	-
Amitriptyline	2	47, 56	-
Citaprolam	14	9.8 - 175	50
Fluoxetine	1	55	-
Mirtazapine	1	54	-
Alpha-OH-alprazolam	2	2.0, 4.5	-
Alpha-OH-midazolam	1	5.8	-
Chlordiazepoxide	4	366 - 1255	845

* Number of positive cases above LOQ, number in parentheses are positive cases between LOD and LOQ

3.5 Discussion of results

3.5.1 Representativeness

All Finnish hospital survey samples were collected in Uusimaa region in southern Finland, which was also the main sample collection area in the roadside survey (D 2.2.3). National data from 2008 was available on the injured driver distribution by the type of vehicle and by the quarter of the year, as presented in Section 1.3. The quarterly distributions of injured drivers in both datasets were similar. For the type of vehicle the only appreciable differences between the two datasets were that the fraction of motorcycles was higher, and the fraction of vans and bicycles was slightly lower, in the survey population than in the national data. It should be remembered that the presented hospitalised driver survey covers only the Uusimaa region, whereas the national statistics are for the whole country. Since the consent rate in the survey was more than 90% it is safe to say that the results are representative of at least the Uusimaa region and, in addition, the survey population shows quite a lot of similarity to the aforementioned national statistics on injured drivers.

3.5.2 Effects of non-response

As presented in Section 3.2 there is unlikely to be any confounding effect due to non-response.

3.5.3 Highlights

Alcohol was the most prevalent substance among injured drivers in Finland, with an occurrence of 21.5%. The second most prevalent substance group was benzodiazepines and Z-drugs, with an occurrence of 9.8%. Almost three quarters of alcohol positive cases were positive for alcohol only. Alcohol only positive cases were more common among young drivers (18-24 years), both male and female, whereas older men had more often some combination of alcohol, medicines and/or illicit drugs. Altogether, the use of medicines and drugs was more common among older drivers. Most of the positive substance findings were from accidents that occurred during nighttime, and the prevalence of alcohol positive cases was up to 50% at night, compared to 16% at day. Also, there were more positive cases during weekends than during weekdays, and the prevalence of alcohol at weekends was double that at weekdays. When comparing the accident types, single vehicle accident cases were more often positive for one or more substances than multiple vehicle cases.

3.5.4 Comparison to other studies

There has been one earlier study on drug use among injured drivers in Finland in 1977 (5). The study was carried out during 16 weeks in spring and autumn. All injured car drivers arrived at any of the five public emergency departments in Helsinki within six hours of the accident were included. In total 203 patients were included and the inclusion rate was estimated to be 90%. Blood serum samples were collected and ethanol (alcohol) and around 50 drugs, including psychotropics and analgesics, were determined from the samples. The control group consisted of randomly selected car drivers (N=352) who were interviewed and breath tested, and a blood sample was collected from 325 drivers. Drivers were interviewed on 14 different days in Helsinki at 10 gas stations during the two time periods in which the patients were studied. Ethanol above 0.2‰ was found in 15% of the accident cases and the most common drug finding was diazepam, in 4.9% of the cases. As stated earlier, ethanol was also the most prevalent substance in our study, and the most common drug finding was diazepam and its metabolite nordiazepam. The prevalence of ethanol was somewhat higher in our study but the prevalence of diazepam (4.6%) was at the same level as in the previous study. The percentage of single vehicle accidents was lower in the 1977 study (only 30%) than that in our study (53%).

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4 Country Report Italy

Authors
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4.1 Description of hospitalised driver sample

According to Annex 1, the specific aim of the hospital survey was to study the prevalence of alcohol and various psychoactive substances in drivers who have been injured and/or killed in traffic accidents, as well as to provide cases for the risk calculation in the case-control study.The hospital study in Italy complied with the general guidelines mentioned in Annex 1 of the Summary Report.

4.1.1 Selection of hospitals

The survey was carried out in close co-operation with the local hospitals. A selection of hospitals was made on the basis of willingness to cooperate, geographical distribution and influx of injured drivers. 4 out of 5 catchment areas of the roadside survey were chosen in the same regions of the selected hospitals in order to have the highest statistical power in risk calculation.

4.1.2 Selection of patients

Only patients that matched a number of well-defined inclusion criteria were selected. The list of inclusion criteria contained both obligatory criteria (see Annex 1) and additional criteria.
The obligatory inclusion criteria were:

- Driver of a motorised vehicle
- Injured in accident on a public road or in the direct vicinity of a public road
- Only primary admissions, not patients transferred from other hospitals
- Admissions because of traumatological reasons
- Time interval between admission and sampling less than 3 hours
- Severity of injuries: as to the severity of injuries, since MAIS (Maximum Abbreviated Injury Scale) is not implemented in Italian hospitals, the criterion to be applied was: prognosis ≥ 20 days.

Additional Italian inclusion criteria were:

- Age. First, it was decided to collect drivers older than 14 (including motorbike drivers) but later it was estabilished to include only drivers older than 18, since informed consent was easier to obtain. (On the whole sample, only six drivers were aged below 18)
- Inclusion of foreign drivers.
- Inclusion of professional drivers
- Collection of urine when available

4.1.3 Data gathered

Because of the low accessibility of the patients (e.g. short stay in hospital, unconsciousness and practical concerns from the hospital staff), it was decided to collect only a limited number of data.

• Patient information:
  o Identification number

- Age
- Gender

• *Toxicological information*:
- Time and date of sampling
- Medication administered prior to blood sampling

• *Accident data*:
- Time and date
- Type of vehicle
- Single vehicle accident: yes/no
- Driver's license: yes/yes, but suspended/no
- Professional use of vehicle: yes/no

4.1.4 Geographical distribution of hospitalised drivers over the region

The geographical distribution of hospitalised drivers over the region is illustrated in the map by encircled provinces. When comparing this distribution with that of the roadside survey, 4 out of 5 areas were covered by selected hospital districts. Most of hospitalised drivers (55%) were collected in Region 03901 (Padova).

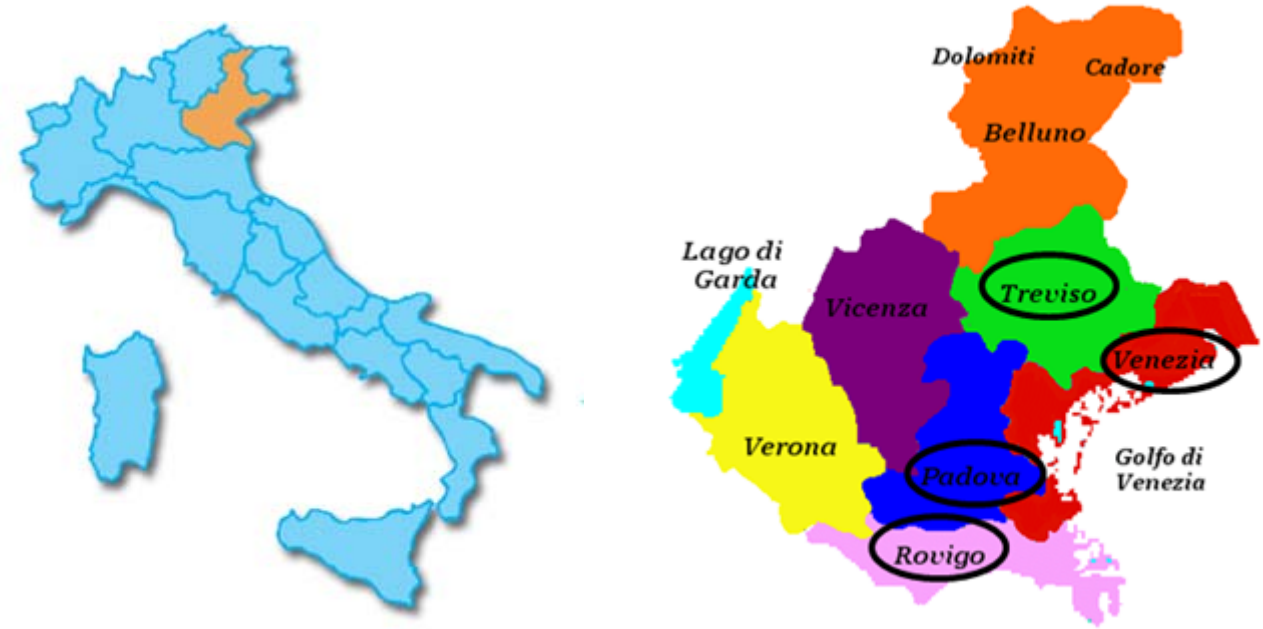

Figure 1. Geographical distribution of drivers over the country

Table 1. Distribution of injured drivers by region

Region Code	Region	Count	Fraction
03901	Padova	377	0.55
03902	Venezia	135	0.20
03903	Treviso	101	0.14
03904	Rovigo	77	0.11
Total		690	1.00

4.1.5 Distribution of hospitalised drivers by season, day of the week and time of the day, age and gender.

The distribution of hospitalised drivers by season, illustrated in Table 2, reveals that most of samples were collected during spring and summer.

Table 2. Distribution of hospitalised drivers by season

Season	Count	Fraction
1 - month 1-3 (winter)	133	0.19
2 - month 4-6 (spring)	224	0. 33
3 - month 7-9 (summer)	232	0.34
4 - month 10-12 (autumn)	101	0.14
Total	*690*	*1.00*

According to the DRUID definition of time periods (see Figure 1), Table 3 shows the distribution of drivers by day of the week and time of the day (8 DRUID Time Period categories). Most of injured drivers were hospitalised during weekend days (44 % of total sampling occurred on Friday evening, Saturday, Sunday and Monday morning).

Table 3. Distribution of hospitalised drivers by time period

Time period (8 DRUID Time Period categories)	Count	Fraction
01	47	0.07
02	103	0.15
03	123	0.18
04	71	0.10
05	37	0.05
06	57	0.08
07	123	0.18
08	90	0.13
Unknown	*39*	0.06
Total	690	1.00

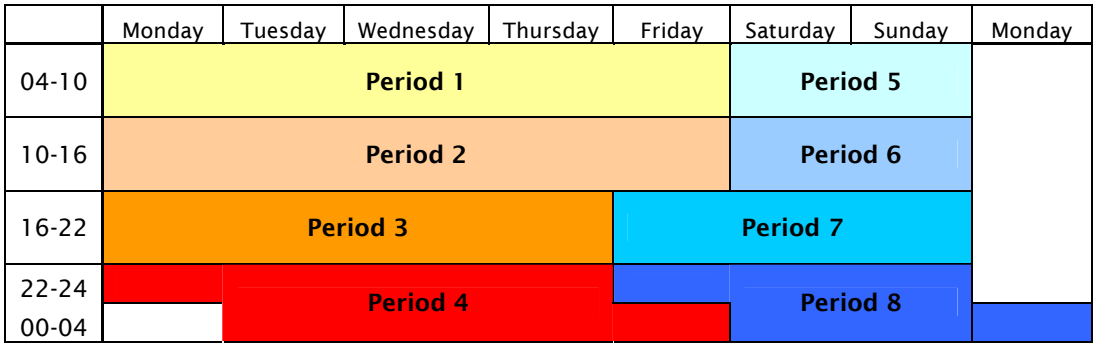

Figure 2. DRUID time periods

As presented in Table 4, the large majority of injured drivers were male (77 %); the age range between 25 and 49 was the most represented in both the male (59%) and the female (65%) groups.

Table 4. Distribution of injured drivers by age and gender. 1= Male, 2 = Female

Gender – age	Count	Fraction
1 – 15-24	107	0.16
1 - 25-34	164	0.24
1 - 35-49	152	0.22
1 - 50+	110	0.16
2 - 18-24	26	0.03
2 - 25-34	47	0.07
2 - 35-49	55	0.08
2 - 50+	29	0.04
Total	690	***1.00***

1.7 Accident Data

The large majority of vehicles involved were cars, accounting for 85 % of the total.

Table 5. Distribution of injured drivers by type of vehicle

Type of vehicle	Count	Fraction
Unknown	62	0.09
Personal car	589	0.85
Personal van	39	0.06
Total	690	1.00

Unfortunately, information on the type of accident, the type of road and the use of safety belt could not be collected.
As to the injury severity, since MAIS was not in use in the selected hospitals, we could only ensure that all selected injured drivers had a prognosis of 20 days or more.

As to the time from accident to sampling, for the majority of included subjects it was, generally, "< 3 hours" as requested by the protocol. In that time interval, however, only for few subjects more details were available as depicted in the following table 6. The few Injured drivers whose time from accident was > 3 h were enrolled but their data were excluded from the study.

Table 6. Time from accident to sampling

Time (h)	Count
< 3	685
0.5	4
0.75	1
1	11
1.2	1
1.33	1
1.5	3
2	3
2.25	1
2.5	6
3	3
4	1
5	2
6	1
19	1

4.2 Methods: sample collection and analysis

Driver participation in the hospital study was, in principle, voluntary. However, the blood sample was taken on arrival during the normal procedure for toxicological screening of blood samples (according to Italian legislation on driving under the influence) and sample left after the analysis performed was stored in the original tube. The analyses for the DRUID protocol at TFA UNPD were then performed using this sample. Written informed consent was obtained from each patient. Anonymity was ensured, all necessary efforts were made to guarantee the privacy of the patient; non-response in collecting blood was thus reduced to zero.

4.2.1 Specimen collection, site of sampling

For blood specimen collection and site of sampling, the procedures described in the summary report were followed. In addition to the common protocol, the Italian HS protocol included also collection of urine samples. 555 out of the 690 subjects included in the present report gave also a urine sample, that was analyzed for the same group of substances as blood.

4.2.2 Toxicological analysis of body fluids

The list of core substances as well as analytical cut-off values for analyses of blood, based on discussions between all DRUID partners, were adopted (see Summary Report). The toxicological analysis were performed at the TFA-UNPD laboratory. A GC-HS-FID method was used for ethanol determination. Two methods were developed, validated and used for the analysis of 30 drugs and metabolites, listed in table 7. The methods are described in Annex 1.

Table 7. Core substances and *additional substances

Core substances and *additional substances
Ethanol
Methamphetamine
6-acetylmorphine
Morphine
Alprazolam
Nordiazepam
Amphetamine
Oxazepam
Benzoylecgonine
Delta-9-tetrahydrocannabinol(THC)
Clonazepam
11-nor-9-carbooxy-tetrahydrocannabinol (THC-COOH)
Cocaine
Zolpidem
Codeine
Buprenorphine*
Diazepam
Norbuprenorphine*
Flunitrazepam
Ketamine*
Lorazepam
Bromazepam*
Methylendioxyamphetamine (MDA)
Methylendioxyethylamphetamine (MDEA)
Fluoxetine*
Methylendioxymetamphetamine (MDMA)
Venlafaxine*
Methadone
Olanzapine*
Zopiclone*

Modified versions of the procedures illustrated in Annex 1 were applied for the analysis of 31 substances and alcohol in urine samples.

4.2.3 Statistical analysis

Statistical analysis was performed without the application of any correction or weighing factor by the standard Excel statistic package.

4.3 **Non-response**

Since it was stressed that the questionnaire was anonymous and all necessary efforts were made to guarantee the privacy of the patient and the confidentiality of the doctor-patient relation, non-response in collecting blood was reduced to zero. Collection of patient information other than age, gender and medication in the hospital prior to sampling was difficult and not achieved in most of cases; accident information from the police could not be obtained, probably because the principles of police work are different from those of research.

4.4 Results

4.4.1 Substance class and group distributions.

The detailed distributions of substance classes and groups (according to agreed group definitions, see figure 2) are represented in tables 8 and 9 for the whole region (4 districts).

Table 8. Substance class distribution

Substance Class	Number of Cases	% of total injured drivers
None	472	68.4%
Illicit Drugs	47	6.8%
Medicinal Drugs	11	1.6%
Illicit + Medicinal Drugs	4	0.6%
Alcohol only	125	18.1%
Alcohol + Illicit	17	2.5%
Alcohol + Medicinal Drugs	11	1.6%
Alcohol + Illicit + Medicinal Drugs	3	0.4%
Total	690	100.0%

Table 9. Substance group distribution

Substance Group	Number of Cases	% of total injured drivers
BAC group = Ethanol concentration		
0 = < 0.1 g/L	534	77.4
1 = 0.1-0.5 g/L	17	2.5
2 = 0.5-0.8 g/L	9	1.3
3 = 0.8 – 1.3 g/L	26	3.8
4 = > 1.3 g/L	104	15.0
Amphetamines	1	0.1
Benzoylecgonine	19	2.7
Cocaine or Cocaine + Benzoylecgonine	18	2.6
Benzodiazepines	5	0.7
THCCOOH	9	1.3
THC or THC + THCCOOH	27	3.9
Medicinal opioids and opioids	21	3.0
Illicit opiates	19	2.8

31.6% of drivers were found positive for one or more (il)licit substances. The highest prevalence was found for alcohol only (18.12%). The sum of injured drivers with ethanol > 0.1 g/L (ethanol alone or in combination with other substances) account for 22.6 % of the total injured drivers; those positive for ethanol at a particularly high concentration (> 1.3g/L) account for 15 % of the total and 67% of the positive-for-alcohol group. 13.3 % of patients had used illicit drugs with the highest prevalence for cocaine (5.4 %) followed by cannabis (5.2 %) . Heroin use was detected in 2.6 % of cases while the prevalence of amphetamines was extremely low.
3.7 % of the sampled subjects were positive for medicinal drugs only, benzodiazepines (0.7%) and medicinal opioids (3.0%) being the most common drugs detected.
No subject was positive for Z-drugs or additional substances other than the core substances.

In Table 10 the distribution of substance groups and substance classes (alcohol, illicit and medicinal drugs) by the 4 districts sampled is presented.

Table 10. Substance group distribution by region. BZE = benzoylecgonine; BDZ = benzodiazepines.

SUBSTANCE(S)	Padova (03901)	Venezia (03902)	Treviso (03903)	Rovigo (03904)	TOTAL
None	252 (66.8%)	95 (70.4%)	70 (69.3%)	55 (71.4%)	472 (68.4%)
BZE	4 (1.0%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	5 (0.7%)
Cocaine only	2 (0.5%)	0 (0.0%)	0 (0.0%)	2 (2.6%)	4 (0.6%)
Amphetamines + Cocaine	1 (0.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
THCCOOH	1 (0.3%)	1 (0.7%)	0 (0.0%)	1 (1.3%)	3 (0.4%)
THCCOOH + Cocaine	0 (0.0%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
THC	5 (1.3%)	4 (2.9%)	2 (2.0%)	2 (2.6%)	13 (1.9%)
THC + BZE	1 (0.3%)	1 (0.7%)	0 (0.0%)	1 (1.3%)	3 (0.4%)
THC + Cocaine	1 (0.3%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	2 (0.3%)
Illicit Opiates	6 (1.6%)	2 (1.5%)	1 (1.0%)	0 (0.0%)	9 (1.3%)
Illicit Opiates + BZE	2 (0.5%)	0 (0.0%)	0 (0.0%)	1 (1.3%)	3 (0.4%)
Illicit Opiates + Cocaine	1 (0.3%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	2 (0.3%)
Illicit Opiates + THC	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.3%)	1 (0.1%)
BDZ	2 (0.5%)	0 (0.0%)	0 (0.0%)	1 (1.3%)	3 (0.4%)
Medicinal opioids	6 (1.6%)	1 (0.7%)	0 (0.0%)	1 (1.3%)	8 (1.2%)
Medicinal opioids + BZE	0 (0.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	1 (0.1%)
Medicinal opioids + Cocaine	1 (0.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
Medicinal opioids + THCCOOH + Cocaine	0 (0.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	1 (0.1%)
Medicinal opioids + THC	1 (0.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
Alcohol only	70 (18.6%)	26 (19.3%)	20 (19.8%)	9 (11.7%)	125 (18.1%)
BZE + Alcohol	5 (1.3%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	6 (0.9%)
Cocaine + Alcohol	1 (0.3%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	2 (0.3%)
THCCOOH + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1.3%)	1 (0.1%)
Cocaine + THCCOOH + Alcohol	2 (0.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.3%)
THC + Alcohol	3 (0.8%)	0 (0.0%)	0 (0.0%)	1 (1.3%)	4 (0.6%)
Cocaine + THC + Alcohol	2 (0.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.3%)
Illicit Opiates + Alcohol	1 (0.1%)	1 (0.7%)	0 (0.0%)	1 (1.3%)	3 (0.4%)
BDZ + Alcohol	1 (0.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
Medicinal opioids + Alcohol	1 (0.3%)	1 (0.7%)	0 (0.0%)	0 (0.0%)	2 (0.3%)
Medicinal opioids + BZE + Alcohol	4 (1.0%)	0 (0.0%)	2 (2.0%)	0 (0.0%)	6 (0.9%)
Medicinal opioids + Cocaine + Alcohol	0 (0.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	1 (0.1%)
Medicinal opioids + THC + Alcohol	1 (0.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
TOTAL	377 (100.0%)	135 (100.0%)	101 (100.0%)	77 (100.0%)	690 (100.0%)

When examining the prevalence distribution by region, results similar to the total prevalence (see last column) are obtained for the category “alcohol only” in 3 out of 4 regions, For the other substance groups (e.g. Cocaine only, THC plus alcohol or substances, medicinal opioids etc), larger variations are onserved among the regions, but the scarce absolute numbers of observations may render these differences unworthy.
It is remarkable that Cocaine, whose circulation is constantly increasing in Italy, has a low total prevalence when considering drivers that test positive for Cocaine alone (0.6%); this prevalence however sharply rises to 5.3 % when considering the concomitant use of Cocaine with alcohol, THC, illicit opiates or medicinal opioids, as witnessed by the sum of subjects positive for Cocaine or Benzoylecgonine and alcohol, or amphetamines, or THC, or THCCOOH, or illicit opiates or medicinal opioids, or a combinations of drugs. As to the use of Cannabis, the prevalence of the active principle THC alone is 1.9%, but it increases to 3.9 % when combined with alcohol and/or other drugs; nonetheless, a larger use of Cannabis, accounting for a total prevalence of 5.2 %, is witnessed by the presence

of the metabolite THCCOOH either alone or combined with alcohol and/or other drugs (2.3 %).

4.4.2 Distribution of substance groups by DRUID time periods aggregated into day (1-3 and 5-7) vs night (4&8), week (1-4) vs WE (5-8)

The detailed substance group distribution by DRUID time periods aggregated into day (1-3 and 5-7) vs night (4&8), week (1-4) vs WE (5-8) is represented in tables 11 and 12 respectively.

Table 11. Substances by DRUID time periods.Day vs Night.

SUBSTANCES	Time Period (Day vs. Night)			
	Unknown	Day (1-3 & 5-7)	Night (4 & 8)	TOTAL
None	30 (76.9%)	367 (74.9%)	75 (46.6%)	472 (68.4%)
BZE	0 (0.0%)	4 (0.8%)	1 (0.6%)	5 (0.7%)
Cocaine only	0 (0.0%)	1 (0.2%)	3 (1.9%)	4 (0.6%)
Amphetamines + Cocaine	0 (0.0%)	1 (0.2%)	0 (0.0%)	1 (0.1%)
THCCOOH	0 (0.0%)	2 (0.4%)	1 (0.6%)	3 (0.4%)
THCCOOH + Cocaine	0 (0.0%)	0 (0.0%)	1 (0.6%)	1 (0.1%)
THC	2 (5.1%)	5 (1.0%)	6 (3.7%)	13 (1.9%)
THC + BZE	0 (0.0%)	3 (0.6%)	0 (0.0%)	3 (0.4%)
THC + Cocaine	0 (0.0%)	1 (0.2%)	1 (0.6%)	2 (0.3%)
Illicit Opiates	0 (0.0%)	8 (1.6%)	1 (0.6%)	9 (1.30%)
Illicit Opiates + BZE	0 (0.0%)	3 (0.6%)	0 (0.0%)	3 (0.4%)
Illicit Opiates + Cocaine	0 (0.0%)	2 (0.4%)	0 (0.0%)	2 (0.3%)
Illicit Opiates + THC	1 (2.5%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
BDZ	0 (0.0%)	3 (0.6%)	0 (0.0%)	3 (0.3%)
Medicinal opioids	1 (2.5%)	6 (1.2%)	1 (0.0%)	8 (1.2%)
Medicinal opioids + BZE	0 (0.0%)	0 (0.0%)	1 (0.0%)	1 (0.1%)
Medicinal opioids + Cocaine	0 (0.0%)	0 (0.0%)	1 (0.0%)	1 (0.1%)
Medicinal opioids + THCCOOH + Cocaine	0 (0.0%)	1 (0.2%)	0 (0.0%)	1 (0.1%)
Medicinal opioids + THC	0 (0.0%)	1 (0.2%)	0 (0.0%)	1 (0.1%)
Alcohol only	5 (12.8%)	70 (14.3%)	50 (31.0%)	125 (18.1%)
BZE + Alcohol	0 (0.0%)	1 (0.2%)	5 (3.1%)	6 (0.9%)
Cocaine + Alcohol	0 (0.0%)	2 (0.4%)	0 (0.0%)	2 (0.3%)
THCCOOH + Alcohol	0 (0.0%)	1 (0.2%)	0 (0.0%)	1 (0.1%)
Cocaine + THCCOOH + Alcohol	0 (0.0%)	0 (0.0%)	2 (1.2%)	2 (0.3%)
THC + Alcohol	0 (0.0%)	1 (0.2%)	3 (0.9%)	4 (0.6%)
Cocaine + THC + Alcohol	0 (0.0%)	1 (0.2%)	1 (0.6%)	2 (0.3%)
Illicit Opiates + Alcohol	0 (0.0%)	2 (0.4%)	1 (0.6%)	3 (0.4%)
BDZ + Alcohol	0 (0.0%)	0 (0.0%)	1 (0.6%)	1 (0.1%)
Medicinal opioids + Alcohol	0 (0.0%)	2 (0.4%)	0 (0.0%)	2 (0.3%)
Medicinal opioids + BZE + Alcohol	0 (0.0%)	2 (0.4%)	4 (2.5%)	6 (0.9%)
Medicinal opioids + Cocaine + Alcohol	0 (0.0%)	0 (0.0%)	1 (0.6%)	1 (0.1%)
Medicinal opioids + THC + Alcohol	0 (0.0%)	0 (0.0%)	1 (0.6%)	1 (0.1%)
TOTAL	39 (100.0%)	490 (100.0%)	161 (100.0%)	690 (100%)

Table 12. Substances by DRUID time period. Week vs weekend.

SUBSTANCES	Week vs. Weekend (WE)			
	Unknown	Week (1-4)	WE (5-8)	TOTAL
None	30 (76.9%)	248 (72.1%)	194 (63.2%)	472 (68.4%)
BZE	0 (0.0%)	2 (0.6%)	3 (1.0%)	5 (0.7%)
Cocaine only	0 (0.0%)	2 (0.6%)	2 (0.6%)	4 (0.6%)
Amphetamines + Cocaine	0 (0.0%)	1 (0.3%)	0 (0.0%)	1 (0.1%)
THCCOOH	0 (0.0%)	2 (0.6%)	1 (0.3%)	3 (0.4%)
THCCOOH + Cocaine	0 (0.0%)	0 (0.0%)	1 (0.3%)	1 (0.1%)
THC	2 (5.1 %)	5 (1.5%)	6 (2.0%)	13 (1.9%)
THC + BZE	0 (0.0%)	2 (0.6%)	1 (0.3%)	3 (0.4%)
THC + Cocaine	0 (0.0%)	2 (0.6%)	0 (0.0%)	2 (0.3%)
Illicit Opiates	0 (0.0%)	3 (0.9%)	6 (2.0%)	9 (1.3%)
Illicit Opiates + BZE	0 (0.0%)	2 (0.6%)	1 (0.3%)	3 (0.4%)
Illicit Opiates + Cocaine	0 (0.0%)	1 (0.3%)	1 (0.3%)	2 (0.3%)
Illicit Opiates + THC	1 (2.6%)	0 (0.0%)	0 (0.0%)	1 (0.1%)
BDZ	0 (0.0%)	2 (0.6%)	1 (0.3%)	3 (0.4%)
Medicinal opioids	1 (2.6%)	4 (1.2%)	3 (1.0%)	8 (1.2%)
Medicinal opioids + BZE	0 (0.0%)	1 (0.3%)	0 (0.0%)	1 (0.1%)
Medicinal opioids + Cocaine	0 (0.0 %)	0 (0.0%)	1 (0.3%)	1 (0.1%)
Medicinal opioids + THCCOOH + Cocaine	0 (0.0%)	1 (0.3%)	0 (0.0%)	1 (0.1%)
Medicinal opioids + THC	0 (0.0%)	1 (0.3%)	0 (0.0%)	1 (0.1%)
Alcohol only	5 (12.8%)	47 (13.7%)	73 (23.8%)	125 (18.1%)
BZE + Alcohol	0 (0.0%)	4 (1.2%)	2 (0.6%)	6 (0.9%)
Cocaine + Alcohol	0 (0.0%)	1 (0.3%)	1 (0.3%)	2 (0.3%)
THCCOOH + Alcohol	0 (0.0%)	1 (0.3%)	0 (0.0%)	1 (0.1%)
Cocaine + THCCOOH + Alcohol	0 (0.0%)	1 (0.3%)	1 (0.3%)	2 (0.3%)
THC + Alcohol	0 (0.0%)	2 (0.6%)	2 (0.6%)	4 (0.6%)
Cocaine + THC + Alcohol	0 (0.0%)	0 (0.0%)	2 (0.6%)	2 (0.3%)
Illicit Opiates + Alcohol	0 (0.0%)	1 (0.3%)	2 (0.6%)	3 (0.4%)
BDZ + Alcohol	0 (0.0%)	1 (0.3%)	0 (0.0%)	1 (0.1%)
Medicinal opioids + Alcohol	0 (0.0%)	2 (0.6%)	0 (0.0%)	2 (0.3%)
Medicinal opioids + BZE + Alcohol	0 (0.0%)	3 (0.9%)	3 (1.0%)	6 (0.9%)
Medicinal opioids + Cocaine + Alcohol	0 (0.0%)	1 (0.3%)	0 (0.0%)	1 (0.1%)
Medicinal opioids + THC + Alcohol	0 (0.0%)	1 (0.3%)	0 (0.0%)	1 (0.1%)
TOTAL	39 (100%)	344 (100%)	307 (100%)	690 (100%)

In general, the higher percentage of positives for alcohol and/or substances (Cocaine, BZE, THC, THC-COOH) were found in drivers injured in accidents during night time; the percentage of subjects positive for alcohol alone is noticeably higher during night time (31.0 *vs* 14.3 % of sampled drivers). However, the % of positives for illicit or medicinal opioids is higher during day time.

As to week *vs* weekend distribution, the proportion of injured drivers found positive for one or more substances were higher in the weekend (36.8 % of sampled drivers) than in the week time period (20.8% of sampled drivers); this difference is particularly remarkable for those positive for alcohol only (23.8 % in WE *vs* 13,. % in week). In Figure 2 the distribution of substance groups according to DRUID time periods aggregated into weekday (1-3), weeknight (4), weekend day (5-7) and weekend night (8) is presented.

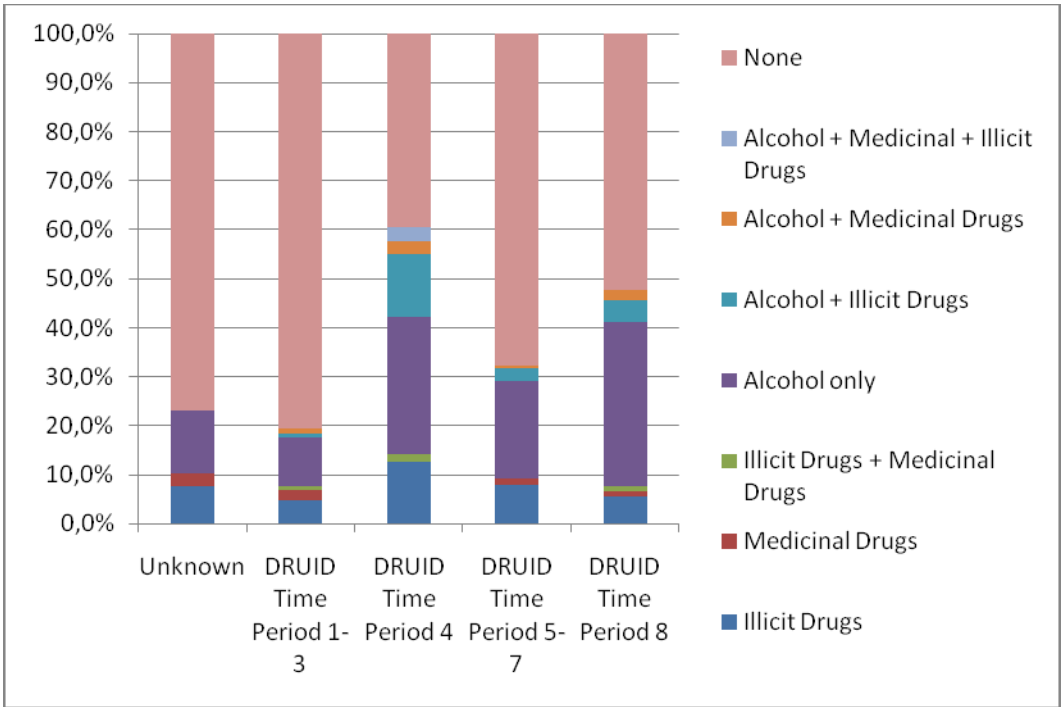

Figure 3. Distribution of substance groups by weekday, weeknight, weekend day and weekend night

4.4.3 Distribution of substance groups by gender and age

The detailed substance group distribution by gender and age is represented in tables 13A and 13B.

Table 13A. Distribution of substances in the Female group by age

	Female				
Substance	**15-24**	**25-34**	**35-49**	**50+**	**Total F**
None	21 (80.8%)	31 (66.0%)	45 (81.8%)	23 (79.3%)	120 (76.4%)
BZE	0 (0.0%)	1 (2.1%)	0 (0.0%)	0 (0.0%)	1 (0.6%)
Cocaine only	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Amphetamines + Cocaine	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
THCCOOH	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
THCCOOH + Cocaine	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
THC	0 (0.0%)	1 (2.1%)	0 (0.0%)	0 (0.0%)	1 (0.6%)
THC + BZE	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
THC + Cocaine	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Illicit Opiates	0 (0.0%)	3 (6.4%)	1 (1.8%)	0 (0.0%)	4 (2.5%)
Illicit Opiates + BZE	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Illicit Opiates + Cocaine	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Illicit Opiates + THC	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
BDZ	0 (0.0%)	1 (2.1%)	0 (0.0%)	2 (6.9%)	3 (1.9%)
Medicinal opioids	0 (0.0%)	1 (2.1%)	1 (1.8%)	0 (0.0%)	2 (1.3%)
Medicinal opioids + BZE	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Medicinal opioids + Cocaine	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Medicinal opioids + THCCOOH + Cocaine	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Medicinal opioids + THC	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Alcohol only	5 (19.2%)	7 (14.9%)	7 (12.7%)	3 (10.3%)	22 (14.0%)
BZE + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Cocaine + Alcohol	0 (0.0%)	1 (2.1%)	0 (0.0%)	0 (0.0%)	1 (0.6%)
THCCOOH + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Cocaine + THCCOOH + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
THC + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Cocaine + THC + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Illicit Opiates + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
BDZ + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Medicinal opioids + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (3.4%)	1 (0.6%)
Medicinal opioids + BZE + Alcohol	0 (0.0%)	1 (2.1%)	0 (0.0%)	0 (0.0%)	1 (0.6%)
Medicinal opioids + Cocaine + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Medicinal opioids + THC + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.6%)
TOTAL Female Substances	26 (100%)	47 (100%)	55 (100%)	29 (100%)	157 (100%)

Table 13B. Distribution of substances in the Male group by age

	Male				
Substances	**15-24**	**25-34**	**35-49**	**50+**	**Total M**
None	67 (62.6%)	96 (58.5%)	100 (65.8%)	89 (80.9%)	352 (66.0%)
BZE	1 (0.9%)	1 (0.6%)	2 (1.3%)	0 (0.0%)	4 (0.8%)
Cocaine only	0 (0.0%)	1 (0.6%)	3 (2.0%)	0 (0.0%)	4 (0.8%)
Amphetamines + Cocaine	0 (0.0%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	1 (0.2%)
THCCOOH	2 (1.9%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	3 (0.6%)
THCCOOH + Cocaine	0 (0.0%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	1 (0.2%)
THC	6 (5.6%)	5 (3.0%)	1 (0.7%)	0 (0.0%)	12 (2.3%)
THC + BZE	2 (1.9%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	3 (0.6%)
THC + Cocaine	0 (0.0%)	1 (0.6%)	1 (0.7%)	0 (0.0%)	2 (0.4%)
Illicit Opiates	1 (0.9%)	2 (1.2%)	2 (1.3%)	0 (0.0%)	5 (0.9%)
Illicit Opiates + BZE	1 (0.9%)	1 (0.6%)	1 (0.7%)	0 (0.0%)	3 (0.6%)
Illicit Opiates + Cocaine	1 (0.9%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	2 (0.2%)
Illicit Opiates + THC	1 (0.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.2%)
BDZ	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Medicinal opioids	0 (0.0%)	2 (1.2%)	3 (2.0%)	1 (0.9%)	6 (1.1%)
Medicinal opioids + BZE	0 (0.0%)	1 (1.2%)	0 (0.0%)	0 (0.0%)	1 (0.2%)
Medicinal opioids + Cocaine	1 (0.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.2%)
Medicinal opioids + THCCOOH + Cocaine	0 (0.0%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	1 (0.2%)
Medicinal opioids + THC	0 (0.0%)	1 (0.6%)	0 (0.0%)	0 (0.0%)	1 (0.2%)
Alcohol only	21 (19.6%)	37 (22.6%)	26 (17.1%)	19 (17.3%)	103 (19.7%)
BZE + Alcohol	1 (0.9%)	3 (1.8%)	2 (1.3%)	0 (0.0%)	6 (1.1%)
Cocaine + Alcohol	0 (0.0%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	1 (0.2%)
THCCOOH + Alcohol	0 (0.0%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	1 (0.2%)
Cocaine + THCCOOH + Alcohol	0 (0.0%)	2 (1.2%)	0 (0.0%)	0 (0.0%)	2 (0.4%)
THC + Alcohol	0 (0.0%)	3 (1.2%)	1 (0.7%)	0 (0.0%)	4 (0.8%)
Cocaine + THC + Alcohol	1 (0.9%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	2 (0.4%)
Illicit Opiates + Alcohol	1 (0.9%)	2 (1.2%)	0 (0.0%)	0 (0.0%)	3 (0.6%)
BDZ + Alcohol	0 (0.0%)	1 (0.6 %)	0 (0.0%)	0 (0.0%)	1 (0.2%)
Medicinal opioids + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.9%)	1 (0.2%)
Medicinal opioids + BZE + Alcohol	0 (0.0%)	1 (0.6%)	3 (2.0%)	0 (0.0%)	5 (1.0%)
Medicinal opioids + Cocaine + Alcohol	0 (0.0%)	0 (0.0%)	1 (0.7%)	0 (0.0%)	1 (0.2%)
Medicinal opioids + THC + Alcohol	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
TOTAL Male Substances	107 (100%)	164 (100%)	152 (100%)	110 (100%)	533 (100%)

The proportion of injured drivers positive for one or more substances is higher in men (34.0 %) than in women (23.6 %). For both male and female drivers, the highest prevalence was found in the age group 25 – 34. Alcohol was the most used substance by both male and female subjects, but the prevalence in the male group was significantly higher (range 17.6 – 22.6 % and total 19.3 % in men vs range 10.3 – 19.2 % and total 14.0 % in women) the highest frequency being in the age group 25 – 34 for the male and 15 -24 for the female group. Whereas Cocaine and THC (alone or in combination with alcohol) were the most prevalent illicit drugs in the male groups, especially below 50, in female subjects only few cases of THC, Cocaine and illicit opiates are present, and in 2 cases only there is a combination with alcohol. Benzodiazepines are used essentially by female subjects.

Unfortunately, the substance group distribution by single-vehicle accidents vs. multiple vehicles could not be calculated due to the lack of data

4.4.4 Distribution of substance concentrations

In Table 14 the range of concentrations measured for the core substances are listed. As expected from cocaine pharmacokinetics, benzoylecgonine exhibited the highest concentrations, both as a maximum and as mean value in blood.

Table 14. Range of substance concentrations. A = alfa-amino

Concentration range (ng/mL)					
SUBSTANCE	**Number of Cases**	**Min**	**Max**	**Median value**	**Mean value**
Alcohol	156	0.1	4.2	1.6	1.65
Morphine	39	1.2	134	17	26.8
Amphetamine	0				
MDMA	1	8.9	8.9	8.9	8.9
MDA	1	6	6	6	6
Cocaine	28	1	127	15.5	51.6
THC	29	0.2	80	1.3	4.5
Diazepam	4	2	120	56.15	63.1
Alprazolam	1	18.5	18.5	18.5	18.5
Clonazepam	0	0	0		
Benzoylecgonine	43	3	420	165	192.95
Codeine	14	3	22	10.5	10.83
6-Acetylmorphine	4	2	5.8	3.15	3.525
Metamphetamine	1	143	143	143	143
Methadone	14	13	190	68.5	79.07
Oxazepam	1	102	102	102	102
Nordiazepam	2	31	38.5	34.75	34.75
Zolpidem	0				
MDEA	0				
THC-COOH	48	1	120	6.5	12.5
Lorazepam	0				
Flunitrazepam	0				
Zopiclone	0				
7-A-Clonazepam	0				
7-A-Flunitrazepam	0				
Tramadol	0				

A short summary of analytical results obtained for the 555 urine samples is reported in Table 15.

Table 15. Substances and concentrations found in 555 urine samples

SUBSTANCES (urine)	Number of Cases	Min	Max	Mean value
Alcohol	90	0.1	4.4	1.8
Morphine	41	10.2	800	285.2
Amphetamine	0			
MDMA	1	800	800	800
MDA	1	279	279	279
Cocaine	31	6	1000	332.1
THC	3	20	160	79.3
Diazepam	2	500	600	550
Alprazolam	0			
Clonazepam	0			
Benzoylecgonine	37	30	1000	431.8
Codeine	28	4.	800	192.5
6-Acetylmorphine	22	11	800	267.5
Metamphetamine	0	0	0	
Methadone	22	102	650	338.8
Oxazepam	2	350	500	425
Nordiazepam	3	100	600	326.7
Zolpidem	0			
MDEA	0			
THCCOOH	42	8.5	194.0	59.6
Lorazepam	0			
Flunitrazepam	0			
Zopiclone	0			
7-A-Clonazepam	0			
7-A-Flunitrazepam	0			
Tramadol	0			

16 % of urine samples were found positive for alcohol, 7.4 % for morphine and 3.5 % for 6-acetylmorphine, whereas those positive for THCCOOH represented 7.6 % of the total samples. In 3 cases only was THC found, as reasonably expected. As to the Cocaine class, 31 out of 555 samples (5.6 %) were positive for Cocaine and 37 out of 555 for BZE (6.7 %). 7 out of 555 cases (1.3%) were positive for benzodiazepines.

4.5 Discussion of results

4.5.1 Representativeness

The Veneto region was chosen due to the vast number of rural, urban, provincial and state roads within the country. Veneto is a large region of Italy that covers a total area of 18,398.9 km^2 that can be divided into four areas: the northern Alpine zone, the hill zone, the lower plain, and the coastal territory. In total there are 7397 kilometres of state regional and provincial roads. The following specific districts were included in our road side survey: Padova, Rovigo, Treviso, Venice, and Vicenza, accounting for more than 8% of the entire population in Italy and in 4 out of 5 districts could a hospital be selected for the hospital survey (see also Table 1).

4.5.2 Non response

No confounding effect due to non-responses in sampling injured drivers was observed.

4.5.3 Highlights

Alcohol was the most prevalent substance among injured drivers in Italy, with a total prevalence of 22.6 % (18.1 % for alcohol only and 4.6 % for combination with an illicit and/or a medicinal drug). The cases positive for alcohol only were more common in male drivers, with prevalence values nearly stable as age increases. Conversely, in the female group, the prevalence for alcohol decreases with increasing age. Positives for "illicit drugs only" represented the second most prevalent group (7.4 %) followed by "medicinal drugs only" (2.9 %) and the combination of illicit and medicinal drugs. The male group in the age range 25 – 34 exhibit the highest prevalence for both alcohol and illicit drugs. The total prevalence of Cocaine (Cocaine alone, Cocaine plus Benzoylecgonine and their combination with alcohol and/or other drugs) accounts for 5.3 % of the total injured driver population. Analogously, the total prevalence of Cannabis is 5.2 %. The use of illicit opiates is documented by an occurrence of 2.8 %, whereas the most of medicinal drugs are represented by medicinal opioids (including methadone). The combinations alcohol-illicit drug were rarely found in the female population.
In general the number of positive drivers was higher during night-time and during weekend with an occurrence of alcohol that was almost double during weekends compared to weekdays, and more than 3 times during night vs daytime.

It must be emphasised that the collection of urine samples proved to be useful in defining the use of illicit opiates in 18 of 39 cases, where 6-acetylmorphine (6-AM) in blood was < 10 ng/mL (DRUID cut off).
A single case of blood containing less than 10 ng/mL of 6-AM (3.1 ng/mL), and for which urine sample was not collected, could also be attributed to illicit opiates use after verification that no opiate medicinal drug was administered to the injured driver prior to sampling.
These results suggest once more that the use of both biological fluids, blood and urine, would facilitate the interpretation of toxicological results in DUI of opiates, and that a cut off of 10 ng/mL can be too high for evidencing 6-AM in blood.
In total, 19 out of 40 cases were attributed to illicit opiates, whereas the other opioids/opiates cases were interpreted as medicinal.

4.5.4 Comparison with other studies

To the best of our knowledge, only a similar study has been conducted in Italy so far: in a town of northern Italy (Modena) and its surrounding territory a total of 115 crash-responsible injured drivers (90 males and 25 females) were enrolled [3]. A urine sample was obtained and different screening and confirmation procedures were employed to detect the presence of drugs and/or alcohol. Among the 115 enrolled drivers, 46 (40%) were positive for at least one drug and/or alcohol. Of these 46 drivers, 66% were positive for a single drug, 25% for two drugs, 9% for three or more drugs. The use of marjuana was found most frequently (19% out of the total 115 enrolled drivers), surpassing alcohol (10%), amphetamines (7%) and cocaine (6%); about 10% tested positive for benzodiazepines. Most drivers positive for alcohol or other drugs were 21-40 years old while the majority of drivers positive for benzodiazepines were 41-70 years old. Thirty-nine (85%) of the positive injured drivers were males and seven (15%) were female. The lower prevalence of total positive samples in the present study (31.6 *vs* 40 %) can be ascribed to the different biological fluids (blood *vs* urine) and selection procedures (general population of injured drivers vs culpable injured drivers) that have been employed. Both studies confirm that the use of alcohol and/or drugs is more prevalent in the youngest driving population, and in the male group.

4.6 Acknowledgements

The authors are grateful to hospital executive personnel for their dedication to make the survey possible.

4.7 References

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4.8 ANNEX 1: Methods of analysis

Sample collection. See 2.1. For the preparation of blanks, calibrators and quality control samples, a pool of drug-free blood was prepared from samples from 6 healthy volunteers.

Liquid chromatography/tandem mass spectrometry for the analysis of illicit drugs and medicines (excluded THC and THC-COOH)

Chemicals.Stock solutions of analytes and internal standards (benzoylecgonine D3, buprenorphine D4, cocaine D3, nordiazepam D5 and methylendioxypropylamphetamine) in methanol or acetonitrile at 1 g/L or 100 mg/L were supplied by Cerilliant (Round Rock, TX, USA) and Lipomed (Arlesheim, Switzerland).

*Standard solutions***.** From individual stock solutions mixed working solutions in methanol at 12.5 mg/L, 2.5 mg/L, 0.5 mg/L and 0.05 mg/L were prepared with the exception of zopiclone. The IS stock solutions were diluted in methanol to give a mixed working solution of 4 mg/L. Zopiclone working solution in acetonitrile at 10 mg/L, 1 mg/L, 0.1 mg/L and 0.01mg/L were prepared weekly and not mixed with the other substances.

*Sample preparation***.** The samples were extracted by solid phase extraction (SPE) using Bond Elut Certify SPE (130 mg - 10 mL; Varian Inc, Palo Alto, CA, USA) columns. 1 ml blood samples were diluted with 6 ml of phosphate buffer, spiked with 20 ⌠L of IS working solution, centrifuged and introduced into the SPE columns conditioned with methanol and phosphate buffer (0.1 M, pH 6). The calibrators and quality control samples were prepared from 1 mL blank blood samples spiked with working solutions of standards and IS and diluted with buffer to the same final volume of samples. The columns were washed with purified water, HCl 0.1 N, and methanol. The elution was carried out with 1 mL of dichloromethane/isopropanol 90:10 (v/v) containing 2% of NH_4OH aqueous solution. Eluates were evaporated at room temperature under a stream of nitrogen and re-dissolved in 50 ⌠L of 5 mM ammonium acetate buffer pH 5.0/acetonitrile (vol/vol, 10:90).

*HPLC Chromatographic conditions***.** An Agilent 1200 HPLC system (Agilent, Santa Clara, CA, USA) was used. The chromatographic separation was performed by a Waters Atlantis T3 (100 x 2.1 mm, 3 μm particle size) column at 40 °C using gradient elution with 5 mM ammonium acetate buffer pH 5.0 (phase A) and acetonitrile (phase B) at a flow rate of 0.3 mL/min. A gradient was programmed by increasing % B as follows: from 10% B to 25 % B in 4 min, hold for 3 min, to 40 % B in 5 min, to 60% in 4 min, to 90 % B in 2 min, hold for 2 min. An injection volume of 5 μL was used.

*Mass spectrometry***.** The HPLC system was combined with an Agilent MSD ion trap mass spectrometer (Agilent, Santa Clara, CA, USA) fitted with an Electrospray (ESI) ionisation source. The mass spectrometer was operated in positive ion mode and in the multiple reaction monitoring (MRM) mode. For collisionally induced dissociations helium was used as a target gas and appropriate tickle voltage, tickle time and q_z values were determined for each substance. The MRM transitions with the corresponding collision voltage and retention time of the analytes and internal standards are presented in Table 16.

*Validation results***.** The method was validated in terms of specificity/selectivity, linearity, limits of quantitation (LOQ), intra-assay precision, inter-assay precision and accuracy (bias). No interferences were detected by analysing 20 drug-free blood samples. The calibration curves, prepared with six points ranging from 1 to 200 μg/L in spiked blood, yielded r^2 ≥0.9889. The LOQs, expressed as the lowest analyte concentration which could be determined with an acceptable level of precision and bias (≤ 20 %), were 0.5 ng/mL for all compounds. The intra- and inter-assay precision and accuracy were

determined by measuring four replicates at two concentration levels (low and high) on four different days (n=16). Precision was expressed as the CV% of the measured values and was always < 15%, with the exception of zopiclone. The accuracy, expressed as bias, was always in the range ± 15 % at the two levels.

Gas chromatography- mass spectrometry for the determination of THC and THC-COOH

Chemicals. Delta-9-tetrahydrocannabinol(THC),11-nor-9-carbooxy-tetrahydrocannabinol (THC-COOH) and the internal standards THC-d3 and THC-COOH-d3 in methanol at 100 mg/L were obtained from Cerilliant (Round Rock, TX, USA).

*Standard solutions***.** From individual stock solutions at 100 mg/L, mixed working solutions in methanol at 5 mg/L, 1 mg/L, 0.500 mg/L, 0.250 mg/L and 0.025 mg/L were prepared. The internal standard (THC-d3 and THC-COOH-d3) stock solutions at 100 mg/L were diluted in methanol to give a mixed working solution of 0.5 mg/L.

Sample preparation. The samples were prepared by liquid-liquid extraction. To 2 ml blood. 5 mL of hexane/ethyl acetate (vol/vol, 90:10) containing 0.4% of glacial acetic acid and 40 ⌈L of IS working solution were added. The calibrators and quality control samples were prepared by spiking 2 mL blank blood with working solutions. The samples were mixed by inversion for 15 min. After centrifugation, the organic phase was transferred to conical tubes and evaporated to dryness at 40 °C under a stream of nitrogen. To the dried extracts 50 μL of trimethylsilyl-trifluoro acetamide containing 1% of trimethylchlorosilane were added as derivatising agent. Derivatisation was achieved by heating at 75 °C for 20 min.

Gas chromatography conditions. An Agilent 6890N gas chromatography (GC) system (Agilent, Santa Clara, CA, USA). The chromatographic separation was performed with an HP Ultra 1 Methyl Siloxane column (12 m x 200 μm o.d., 0.33 μm film thickness). Helium at a constant flow of 0.8 mL/min was used as a carrier gas. 1 μL of derivatised extracts was injected by splitless injection at 250°C. The initial oven temperature of 80 °C was held for 1 min, followed by an increase to 300°C at 25°C/min with 2 min hold.

*Mass Spectrometry***.** All mass spectrometric measurements were performed on an Agilent 5973 MS single quadrupole mass spectrometer (Agilent, Santa Clara, CA, USA). The single quadrupole was operated in Electron Ionisation (EI) conditions (70 eV, 200 μA) and in single ion monitoring mode. The following ions were monitored: for THC ions at *m/z* 303, 371 and 386; for THC-COOH ions at *m/z* 371, 473 and 488; for the IS THC-d3 ions at *m/z* 306, 374 and 389; for the IS THC-COOH-d3 ions at *m/z* 374, 476 and 491.

*Validation results***.** No interferences were detected by analysing 20 drug-free blood samples. The calibration curves, prepared with six points ranging from 0.2 to 20.0 μg/L THC and THC-COOH in spiked blood yielded r^2 ≥0.999. The LOQs resulted to be 0.2 μg/L for THC and THC-COOH. The intra- and inter-assay precision and accuracy were determined by measuring four replicates at two concentration levels (1 μg/L and 5 μg/L) on four different days (n=16). The intra-assay precision was found to be 3.2 and 1.9 % and the inter-assay precision 3.5 and 2.3 % for the lower and higher concentration levels, respectively. The accuracy (bias) was found to be +1.2 and +0.8% for the lower and higher concentration levels, respectively.

BAC quantification by Headspace Gas Chromatography

Chemicals. Absolute 200 proof ethanol, LC grade *iso*-propanol, sodium chloride, and sodium fluoride were obtained from Sigma Aldrich (Milan, Italy). Acetaldehyde, LC grade

methanol, acetone, n-propanol, methyl,ethyl ketone and toluene were purchased from Merck Chemicals (Milan, Italy). Purified water was obtained with a Milli-Q system (Millipore).

*Standard solutions***.** Ethanol working solutions in purified water at 1, 2 and 5 g/L were prepared and used for the validation and preparation of calibration curves. *Iso*-propanol (IS) working solution was prepared in purified water at 0.5 g/L. Ethanol Standards (0.05%, 0.08%, 0.10%, 0.20% and 0.30% w/v) NIST traceable were purchased from Cerilliant (Round Rock, TX, USA) and used as quality controls.

*Sample preparation***.** 750 mg sodium chloride, 40 mg sodium fluoride, 0.5 mL of IS working solution and water to a final volume of 1.5 mL were added to 0.5 mL blood in a 20 mL glass headspace vial. The calibrators and quality control samples were prepared by adding to 0.5 mL blank blood samples or to water the appropriate working solution volumes. Headspace-Gas Chromatography (HS-GC) conditions**.** An Agilent 7694 gas chromatograph (GC) with flame ionisation detector and a headspace autosampler was used. The chromatographic separation was performed on J&W DB-ALC1 (30 m x 0.534 µm x 3.00 µm) column. The GC operational parameters were: oven 50º C isothermal, injector 250 ºC, detector (FID) 250 ºC, hydrogen flow 35 mL/min, Air flow 450 mL/min, Make-up gas (nitrogen) flow 22.6 ml/min. The injection was in split mode with a split ratio 1:50. The HS sampler parameters were: sample oven 75 ºC, sample equilibration 10 min, sample inject 1.00 min.

Validation results. Volatiles were identified based on relative retention times compared to calibrators. Linearity was evaluated by the preparation of calibration curves with 5 points ranging from 0.01 to 0.05 % w/v. The r^2 value for the linear regression curve was always 0.997 or greater. A study was run to evaluate the interferences of other volatile substances (acetaldehyde, methanol, acetone, n-propanol, toluene and methyl ethyl ketone). The peaks were resolved with a resolution better than 1 and a peak-to-valley ratio better than 90%. The precision, accuracy, and limit of quantitation (LOQ) were determined by ten replicate measurements of ethanol at different concentrations; precision was defined as the coefficient of variation (CV%); accuracy was defined as the deviations from the actual concentration. The LOQ was determined to be 0.010% w/v. .At concentrations of 0.010, 0.050, 0.100, 0.200 and 0.300 % precisions were 1.8%, 0.4%, 0.2%, 0.5%, 0.2% respectively and accuracies were +13.0%, +8.5%, -1.8%, +0.6%, -1.6%.

Table 16. Validation parameters of the LC-MS/MS method

Compound	Rt (min)	Fragmentation amplitude (V)	Transitions (m/z)	IS	R2	Intra-assay % CV Low	Intra-assay % CV High	Inter-assay %CV Low	Inter-assay %CV High
6-Acetylmorphine (6-MAM)	6.4	1.10	328 → 268	cocaine D3	0.9961	6.2	4.5	10,0	9,8
7-aminoclonazepam	9.9	1.00	286 → 250	nordiazepam D5	0.9940	7.2	5.4	9.5	5.0
7-aminoflunitrazepam	11.7	1.00	284 → 135	nordiazepam D5	0.9920	4.3	4.2	13.8	9.1
alprazolam	17.2	1.20	309 → 281	nordiazepam D5	0.9889	8.5	9.8	14.8	13.0
amitriptyline	17.0	1.10	278 → 233	cocaine D3	0.9940	5.4	2.2	9.3	8.5
amphetamine	5.9	1.10	136 → 119	MDPA	0.9928	4.3	3.6	11.9	7.0
benzoylecgonine	7.7	1.20	290 → 168	benzoylecgonineD3	0.9942	4.1	4.3	13.5	12.8
bromazepam	14.7	1.00	316 → 182	nordiazepam D5	0.9918	3.7	3.2	14.1	10.5
buprenorphine	15.4	1.00	468 → 414	buprenorphine D4	0.9958	2.9	1.8	7.9	6.5
clonazepam	17.5	0.90	316 → 270	nordiazepam D5	0.9989	3.8	2.6	14.1	12.5
cocaine	9.9	1.00	304 → 182	cocaine D3	0.9928	4.6	5.4	10.7	5.9
codeine	4.9	1.00	300 → 215	cocaine D3	0.9972	3.8	2.5	11.1	14.3
diazepam	19.9	0.90	285 → 193	nordiazepam D5	0.9958	5.5	4.2	16.3	9.7
flunitrazepam	18.3	1.10	314 → 268	nordiazepam D5	0.9930	6.1	5.3	11.5	9.8
fluoxetine	17.3	1.20	310 → 148	cocaine D3	0.9990	3.5	2.9	12.4	8.7
ketamine	8.1	0.90	238 → 220	MDPA	0.9978	4.5	4.0	14.3	10.3
lorazepam	17.3	1.10	322 → 305	nordiazepam D5	0.9880	9.8	8.0	14.7	10.5
metamphetamine	6.6	1.10	150 → 119	MDPA	0.9928	6.0	4.5	12.3	8.8
methadone	17.2	1.20	310 → 265	cocaine D3	0.9989	3.1	2.8	8.5	6.5
methylendioxyamphetamine (MDA)	6.4	1.00	180 → 163	MDPA	0.9937	5.5	6.5	10.9	10.5
methylendioxyethylamphetamine (MDEA)	7.7	1.00	208 → 163	MDPA	0.9962	4.8	4.1	9.9	8.5
methylendioxymetamphetamine (MDMA)	6.9	0.90	194 → 163	MDPA	0.9948	5.9	4.2	8.0	6.6
morphine	2.2	1.10	286 → 201	cocaine D3	0.9989	5.0	3.2	7.7	6.6
norbuprenorphine	11.4	1.30	414 → 396	buprenorphine D4	0.9995	3.9	2.4	7.0	5.4
nordiazepam	18.5	0.90	271 → 208	nordiazepam D5	0.9943	5.5	4.9	9.1	8.7
olanzapine	8.2	1.20	313 → 256	MDPA	0.9961	4.0	3.5	5.8	6.0
oxazepam	16.9	0.80	288 → 241	nordiazepam D5	0.9921	3.7	2.9	8.1	7.2
venlafaxine	11.5	1.10	278 → 260	cocaine D3	0.9989	3.5	1.9	6.0	5.3
zolpidem	11.1	1.10	308 → 263	cocaine D3	0.9925	3.0	2.0	5.5	5.3
zopiclone	8.8	0.80	389 → 345	MDPA	0.9918	10.5	9.3	16.2	14.8
benzoylecgonine D3(IS)	7.6	1.00	293 → 171	-					
buprenorphine D4 (IS)	15.4	1.00	472 → 415	-					
cocaine D3 (IS)	9.9	1.00	307 → 185	-					
methylendioxypropylamfetamine (MDPA) (IS)	9.0	0.90	222 → 163	-					
nordiazepam D5	18.4	0.90	276 → 213	-					

5 Country Report Lithuania

Authors
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5.1 Description of the hospitalised drive sample

The hospital survey (HS) in Lithuania have been carried out from 1st of April 2008 until 20th of March 2010 to assess the situation in country regarding the prevalence of alcohol and other psychoactive substances in accident involved drivers. The hospital survey design was set up following the recommendations of DRUID project protocols. The research areas of Lithuania (see Figure 1) were based on the geographical distribution of population over the country, accounting for 3,350 mln. inhabitants in total. All studies and study protocols were approved by Lithuanian Bioethics Commission according to the code of ethics on human experimentation established by the declaration of Helsinki (1964) and amended in Edinburgh (2000).

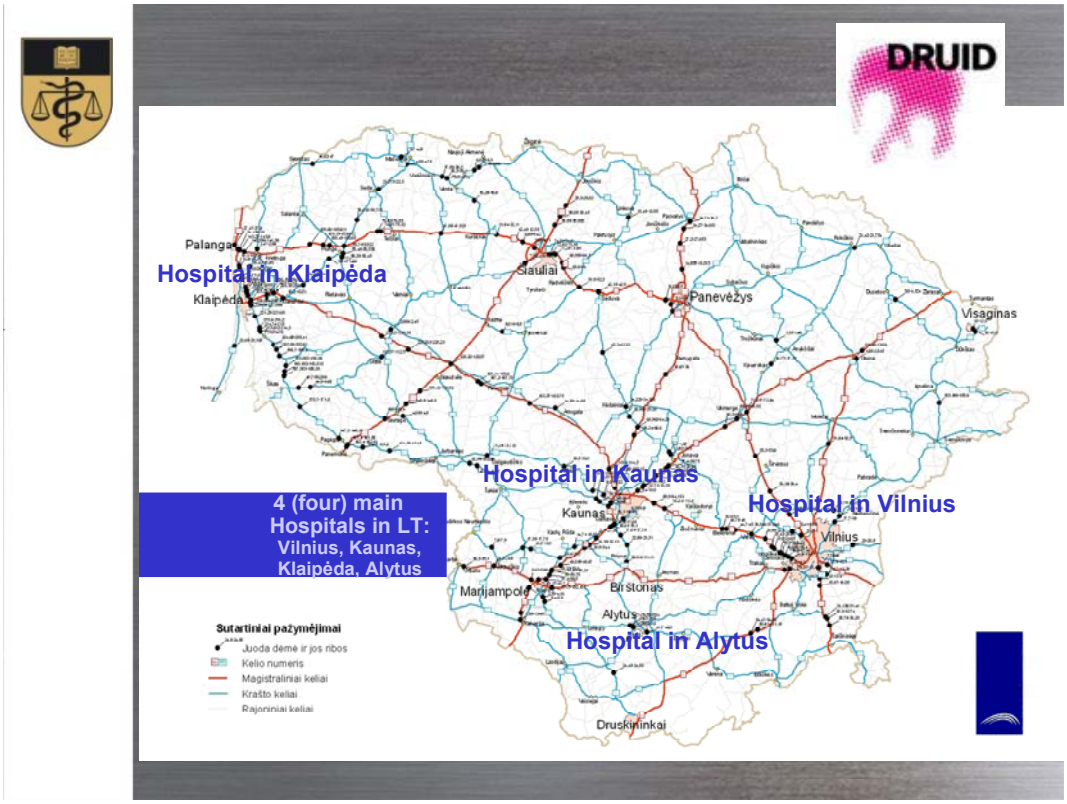

Figure 1. The research areas of Lithuania: Vilnius, Kaunas, Klaipeda, and Alytus

Figure 1 shows the geographical distribution of the hospital survey areas in Lithuania and the four main hospitals involved in the HS.
The uniform protocol on the hospital survey and all procedures were prepared and adapted by the working paper "Uniform design and protocols for carrying out hospital

survey" (revision date: 29/06/2007) of DRUID. Information and the design on the uniform hospital survey were sent to the administration departments of four hospitals in Vilnius, Kaunas, Klaipeda and Alytus. The uniform questionnaire form in Lithuanian language for the hospital survey was prepared following the DRUID project recommendations. The administration and hospital staff was informed on study requirements and procedures. The questionnaire form collects data information on injured drivers such as age, gender, time of accident, vehicle type, driver's licence, the use of any infusions or medicines by ambulance staff.
The blood samples were collected from injured drives (from MAIS 2 and >) and sent to the TMI Toxicology laboratory with the filled questionnaire. During the hospital survey 424 samples were collected.

Table 1 presents the distribution of injured drivers by region and hospital: the highest percentage of injured drivers was from Kaunas research region - 83.96% which is in urban area of Lithuania in cross connection with main urban roads, from Vilnius research region (capital of Lithuania) - 14.62% (see Table 1).

Table 1. Distribution of injured drivers by region and hospital

Region and Hospital	Distribution of injured drivers
Vilnius 37001	62 (14.62%)
Kaunas 37002	356 (83.96%)
Klaipeda 37003	4 (0.94%)
Alytus 37004	2 (0.47%)
Total	424

Table 2 presents the distribution of injured drivers by road type: the highest percentage of injured drivers was from urban road type - 98.10% and rest of drivers - 1.9% were from rural roads (see Table 2).

Table 2. Distribution of injured drivers by road type

Road type	Distribution of injured drivers
Urban road	414 (98.10%)
Rural road	8 (1.90%)
Total	422 (100%)
Frequency Missing = 2	

Table 3 presents the distribution of injured drivers by day of the week and time of the day: the highest percentage of injured drivers was in the weekday period - 65,23 %, the rest of drivers: 25.38% - in weekend day, 6.35% - in weekend night and 3.05% – in weeknight. The high percentage of injured drives during the daytime hours was caused by the much higher traffic volumes during daytime hours than during night time hours (see Table 3).

Table 3. Distribution of injured drivers by day of the week and time of the day

Time period	Distribution of injured drivers
Weekday	257 (65.23%)
Weeknight	12 (3.05%)
Weekend day	100 (25.38%)
Weekend night	25 (6.35%)
Total	**394 (100%)**
Frequency Missing = 30	

Table 4 presents the distribution of injured drivers by season (quarter): no big difference on injured drivers was found by the seasons of the year (see Table 4).

Table 4. Distribution of injured drivers by season (quarter)

Quarter	Distribution of injured drivers
1st quarter	116 (27.36%)
2nd quarter	106 (25.00%)
3rd quarter	81 (19.10%)
4th quarter	121 (28.54%)
Total	424 (100%)

Table 5 presents the distribution of injured drivers by severity: the highest percentage of injured drivers was in MAIS2 group (86.55%) followed by MAIS 3 (7.6%) and MAIS 4 (3.51%). Both MAIS 1 and 6 were observed in only one case. In 253 cases the MAIS was not indicated (see Table 5).

Table 5. Distribution of injured drivers by severity

MAIS	Distribution of injured drivers
MAIS 1	1 (0.58%)
MAIS 2	148 (86.55%)
MAIS 3	13 (7.60%)
MAIS 4	6 (3.51%)
MAIS 5	2 (1.17%)
MAIS 6	1 (0.58%)
Total	171 (100%)
Frequency Missing = 253	

Table 6 presents the distribution of injured drivers by age and gender: no big significant difference found in distribution by age groups both in males and females from age 18 till age 50. In male group the number of injured drivers was higher than in a female group (see Table 6).

Table 6. Distribution of drivers by age and gender

Table of age by gender			
Age	**gender**		**Total**
	male	**female**	
18-25 years	77 (30.20%)	38 (27.94%)	115 (29.41)
25-35 years	65 (25.49%)	42 (30.88%)	107 (27.37)
35-50 years	70 (27.45%)	41 (30.15%)	111 (28.39%)
50 years and older	43 (16.86%)	15 (11.03%)	58 (14.83%)
Total	255 (100%)	136 (100%)	391 (100%)
Frequency Missing = 33			

Table 7 presents the distribution of injured drivers by type of vehicle: the highest percentage of injured drivers was in personal car drivers group - 84.88% (see Table 7).

Table 7. Distribution of drivers by type of vehicle

Vehicle type	Distribution injured drivers
personal cars	348 (84.88%)
vans	27 (6.59%)
motorcycle	31 (7.56%)
bicycle	1 (0.24%)
bus/truck >3500kg	3 (0.73%)
Total	410 (100%)
Frequency Missing = 14	

Table 8 presents the distribution of injured drivers by accident type: the highest percentage of injured drivers was in the multi-part accident type group - 68.22% (see Table 8).

Table 8. Distribution of drivers by accident type

Accident type	Distribution injured drivers
single-vehicle accident	130 (31.78%)
multi-part accident	279 (68.22%)
Total	409 (100%)
Frequency Missing = 15	

5.2 Methods: Data collection and analysis

5.2.1 Ethical approval

TMI submitted all the documents required for receiving the permission for implementation of the DRUID project in Lithuania to the Lithuanian Bioethical Committee in November, 2007. The documents were prepared following the Committee's previous recommendations and remarks. The written consent (including some remarks) from the Committee was received at TMI on November 21, 2007 (Lithuania's Bioethical Committee's official letter No.6B-07-386 (Code 07-11-01).

5.2.2 Data collection procedure:

Data and sample collection in Task 2.2a, 2.2b, 2.3 has been started following the relative protocols, procedures and other requirements. The blood samples were collected from severe injured drives at the moment of arrival to the hospital. Time between accident and sampling time was not longer than 3 hours. The questionnaire form was filled by hospital staff and sent together with a blood sample to TMI Toxicology laboratory.

5.2.3 The transportation and storage of blood samples:

The blood samples were collected in 6 ml vacuum blood tubes, made by „Vacuette“ firm containing sodium fluoride and potassium oxalate, the blood samples were transported at 4°C to the TMI Toxicology Laboratory for analyses. The blood samples were storage at -20°C.

5.2.4 Toxicological analysis:

The toxicological methods regarding the blood sample analyses in the above tasks have been set up in the TMI Toxicology laboratory in Vilnius, Lithuania. During the joint workshop at LMU (Muenchen, February 18-22, 2008) TMI experts-toxicologists have

undergone inter-lab quality control. The TMI Toxicology laboratory has undergone the Round Robin test - the proficiency testing.

The methods used for toxicological analysis in TMI Toxicology Laboratory for:

AMPHETAMINES:
LLE
1ml whole blood + 1ml H2O + 50µl IS + 200µl 8N NaOH + 5ml 1-chlorobutane. Vortex 1 min. Organic layer + 1ml 0,2N H_2SO_4. Vortex 2 min.
Aqueous layer + 100µl 8N NaOH + 1,2ml 1-chlorbutane**.** Vortex 2 min.
Organic layer +100µl tartaric acid in ethylacetate. Evaporate at 40°C, N_2 Equipment: Caliper Turbo Vap LV

Derivatisation
+ 50µL ethylacetate + 50µg HFBA. 20min. at 70°C. Equipment: Pierce Reacti-Therm III
+100µl tartaric acid in ethylacetateat. Evaporate at 40°C, N_2 Equipment: Caliper Turbo Vap LV
Reconstitution:50µL ethylacetate.

IS:

Amphetamine-D5	Cerilliant, 1mg/mL	1000 ng/mL
Metamphetamine-D5	Cerilliant, 1mg/mL	1000 ng/mL
MDA-D5	Cerilliant, 1mg/mL	1000 ng/mL
MDMA-D5	Cerilliant, 1mg/mL	1000 ng/mL
MDEA-D5	Cerilliant, 1mg/mL	1000 ng/mL

Chromatographic conditions:
Chromatographic system: Agilent technologies 7890A
Column: DB-5ms (Agilent technologies, ID -0,25 mm, length – 30 m, 5% Phenyl Arylene polymer, non-polar)
Carrier gas: Helium
Temperature gradient: 100°C(1,0)→20°C/min→200°C→30°C/min→300°C(7)
Injection: 2µl
Mass Spec conditions:
MS system: Agilent technologies 5975C inert XL MSD with Triple Axis Detector; EI 70 V

Compound	Rt	TIon (m/z)	QIon (m/z)
Amphetamine-D5 (IS)	5.11	244	123
Amphetamine	5.13	240	91; 118
Methamphetamine-D5(IS)	6.03	258	213
Methamphetamine	6.06	254	118; 210
MDA-D5(IS)	7.67	167	268
MDA	7.69	162	240; 375
MDMA-D5(IS)	8.25	258	213
MDMA	8.27	254	162; 210
MDEA-D5(IS)	8.43	273	408
MDEA	8.45	268	240; 403

COCAINE and OPIATES
SPE

Columns: mixed mode, Grace 3 ml/200mg Drug-Clean, Alltech Associates

Sample:
1 ml whole blood + 4 ml H_2O + 50 µl IS
+ 2 ml phosphate buffer pH-6,2 (K_2HPO_4 x $3H_2O$)

Column conditioning	3 ml Methanol 3 ml H_2O 1 ml phosphate buffer pH-6,2

Washing:	2 ml H_2O 2 ml 0,1 N HCl 3 ml Methanol

Elution:	1 x 3 ml CH_2Cl_2/IPA/NH_4OH (78:20:2) 40 ml 2-propanol + 4 ml NH_4OH. Mix + 156 ml dichlormethane

Evaporate at 40°C, N_2 Equipment: Pierce Reacti-Therm III

Derivatisation
+ 50 µl Ethyl acetate + 40 µl BSTFA. 20min. at 100°C. Equipment: Pierce Reacti-Therm III

IS:

ME-D3	Cerilliant, 0,1mg/mL	1000 ng/mL
Cocaine-D3	Cerilliant, 1mg/mL	1000 ng/mL
BE-D	Cerilliant, 1mg/mL	10 000 ng/mL
Codeine-D3	Cerilliant, 1mg/mL	2000 ng/mL
Morphine-D3	Cerilliant, 1mg/mL	2000 ng/mL
6MAM-D3	Cerilliant, 1mg/mL	2000 ng/mL

Chromatographic conditions:
Chromatographic system: Agilent technologies 7890A
Column: DB-5ms (Agilent technologies, ID -0,25 mm, length – 30 m, 5% Phenyl Arylene polymer, non-polar)
Carrier gas: Helium
Temperature gradient (opiates): 150C (3,0) → 10C/min. → 280C (0,0) → 40C/min. → 300C (8,0)
Temperature gradient (cocaine): 80C (4,0) → 40C/min. → 240C (6,0) → 30C/min. → 290C (0,0)
Injection: 2µl

Mass Spec conditions:
MS system: Agilent technologies 5975C inert XL MSD with Triple Axis Detector; EI 70 V

Compound	Rt	TIon (m/z)	QIon (m/z)
ME-D3(IS)	6.98	85	185; 274
ME	6.99	82	182; 271
Cocaine-D3(IS)	8.87	185	201; 306
Cocaine	8.88	182	198; 303
BE-D3(IS)	9.07	243	364
BE	9.08	240	256; 361
Codeine-D3(IS)	15.09	374	346
Diphenhydramine	9.62	58	152; 165
Tramadol	10.52	58	245; 335
Methadone	12.37	72	165; 178
Codeine	15.12	371	234; 343
Morphine-D3(IS)	15.47	432	417
Morphine	15.49	429	401; 414
6-MAM-D3(IS)	16.02	402	343
6-MAM	16.04	399	287; 340
Zolpidem	17.9	235	219; 307
Buprenorphine	23.44	450	482

CANNABINOIDS
SPE
Columns: non-polar, Chromabond C8 1 ml/100 mg, Macherey-Nagel Gmbh & Co.

Sample:
1 ml whole blood + 1 ml IS + 2 ml H_2O

Column conditioning	2x1ml Methanol 2x1ml H_2O

Washing:	1ml H_2O 1ml 0.25M acetic acid 1ml H_2O

Elution:	2x1ml Acetone

Evaporate at 40°C, N_2 Equipment: Caliper Turbo Vap LV

Derivatisation
+ 150 µl DMSO/TBAH (1ml: 980 µl DMSO/ 20 µl TBAH)
+ 50 µl Jodmethane, 25-30 min room temperature
+ 350 µl 0,1 M HCl + 1 ml Isooctane
Organic layer evaporate at 40°C, N_2 Equipment: Caliper Turbo Vap LV
Reconstitute in 40 µl Ethylacetate

IS:

THC-D3	Cerilliant, 0,1mg/mL	30 ng/mL
THC-OH-D3	Cerilliant, 0,1mg/mL	20 ng/mL
THC-COOH-D3	Cerilliant, 0,1mg/mL	30 ng/mL

Chromatographic conditions:
Chromatographic system: Agilent technologies 7890A
Column: DB-5ms (Agilent technologies, ID -0,25 mm, length – 30 m, 5% Phenyl Arylene polymer, non-polar)
Carrier gas: Helium
Temperature gradient: 150C (0,0) → 25C/min. → 280C (9,8)
Injection: 2µl

Mass Spec conditions:
MS system: Agilent technologies 5975C inert XL MSD with Triple Axis Detector; EI 70 V

Compound	Rt	TIon (m/z)	QIon (m/z)
THC-D3(IS)	6.03	316	248; 331
THC	6.04	328	245; 285
THC-OH-D3(IS)	6.69	316	260; 361
THC-OH	6.7	313	257; 358
THC-COOH-D3(IS)	7.35	316	360; 375
THC-COOH	7.36	313	357; 372

BENZODIAZEPINES
LLE
200µl whole blood + 100µl K_2HPO_4 (PBS pH-9,2) + 300µl organic mix from (n-Butylacetate and IS Flurazepam 200 ng/mL),
Vortex 1 min.

Derivatisation
50µl Upper organic layer transfer to chromatography vials + 10µl (MTBSTFA)Vortex 0,1 min., 20min. at 90°C. Equipment: Pierce Reacti-Therm III
IS:

Flurazepam	Lipomed	200 ng/mL

Chromatographic conditions:
GC/NICI-MS system, Agilent 5975C inert XL el/cl MSD GC System
Column: Agilent 123-5731 DB-5HT, max. 400 ºC, 30 m, 0,320 mm, 0,1 µm particle size.
Carrier gas: Helium
Chemical ionisation gas – methan (purity 5,5)
Temperature gradient: 180C (0) → 50ºC/min. → 325ºC → (2,0) Run Time- 4,9 min
Injection: 2µl

Mass Spec conditions:

Compound	Retention time (min)	TIon (m/z)	QIon (m/z)
Flurazepam (IS)	2.57	387	389
Diazepam	2.05	284	286
Flunitrazepam	2.32	313	314
Oxazepam	2.49	268	270
Lorazepam	2.70	302	304
Alprazolam	2.84	308	310
Zopiclone	3.03	143	246
Nordazepam	2.11	234	384
7-amino-clonazepam	2.62	249	363
Clonazepam	2.73	429	431

ETHANOL
IS: 0,1 % 1-propanol
Chromatographic conditions:
Chromatographic system: Perkin Elmer Clarus 500 TurboMatrix110
Column 1: Elite BAC1 (PE: 0,18x10x1,0)
Column 1: Elite BAC2 (PE: 0,18x10x0,63)
Carrier gas: Helium
Temperature: 35C
Injection: 2µl

Controls for:
Benzodiazepines – Medidrug Benzodiazepine S, level 1 (serum cotrol). Remark: used serum control as not produsing the controls in blood.

Other – Medidrug BTMF 2/---B, drugs of abuse, whole blood control with reference values.
Alkohol – Medidrug Ethanol VB-plus, Blood alcohol- Whole blood control (human). C%: 0,5 g/L; 0,8 g/L ir 1,1 g/L. Folowing concentrations produced: 0,2 g/L ir 4,0 g/L

Validation data see in Annex 1.

5.3 Results

5.3.1 Substance group distribution

Table 9 presents the general distribution of substance groups. The toxicology results on the injured drivers show that 307 (72.41%) drivers were negative for the investigated core substances. Only one driver was positive for amphetamines, two for cocaine, one for THC and 11 for benzodiazepines. Drug-drug combinations were found in 4 drivers, the medicinal opioids and opiodes were found in 24 drivers. 63 (14.86%) injured drivers were found positive for alcohol only and 11 (2.59%) drivers for the combination alcohol and drugs (see Table 9).

Table 9. Substance group distribution

Substances	Distribution of injured drivers
Negative	307 (72.41%)
Amphetamines	1 (0.24%)
Cocaine	2 (0.47%)
THC	1 (0.24%)
Benzodiazepines	11 (2.59%)
Drugs-drugs combination	4 (0.94%)
Medicinal opioids	24 (5.66%)
Alcohol	63 (14.86%)
Alcohol+drugs	11 (2.59%)
Total	424 (100%)

5.3.2 Distribution of substance groups by DRUID time periods aggregated into day (1-3 & 5-7) vs. night (4&8), week (1-4) vs WE (5-8)

Table 10 presents the distribution of substance groups by DRUID time periods. The lowest percentage of subjects tested negative was found in weekend nights. Alcohol

(alone or in combination) was most prevalent in all time periods, there was no large difference in prevalence between weekdays (15.5%), weeknights (16.6%) and weekend days (18%), while a higher percentage of positive findings for alcohol only was found on weekend nights (32%) (see Table 10). No alcohol-drug combination was found in week nights. Benzodiazepines and drug-drug combinations were only found during week- and weekendday.

Table 10. Distribution of substance groups by druid time periods

	Weekday	Weeknight	Weekend day	Weekend night
Negative	190 (73.93%)	10 (83.33%)	73 (73%)	13 (52%)
Amphetamines	1 (0.39%)	0	0	0
Cocaine	1 (0.39%)	0	0	1 (4%)
THC	0 (0%)	0	0	1 (4%)
Benzodiazepines	8 (3.11%)	0	3 (3.0%)	0
Drugs-drugs combi	3 (1.17%)	0	1 (1%)	0
Medicinal opioids	14 (5.45%)	0	5 (5%)	2 (8%)
Alcohol	34(13.2%)	2 (16.6%)	15 (15%)	7 (28%)
Alcohol+drugs	6 (2.33%)	0	3 (3%)	1 (4%)
Total	257 (100%)	12 (100%)	100 (100%)	25 (100%)

5.3.3 Distribution of substance groups by gender and age

The distribution of substance groups by gender and age was shown in Table 11(Male) and Table 12 (Female).
In the male subpopulation the highest percentage of drivers tested positive for alcohol was found in the age group 18-24 (22.08%). The combination alcohol-drug was found most in the age group 35-49 (4.29% and 7.32% for resp male and female).
In male drivers the medicinal opioids were most prevalent in the age group 50+ (13.95%) followed by the group 18-24 (10.4%), while in female drivers medicinal opioids were only found in the age groups 25-34 (2.38%) and 35-49 (4.88%).
In the male subpopulation the highest percentage of positive findings for benzodiazepines was observed in the age group 50+ (6.98%), in female group the highest percentage was found in the age group 25-34 (4.76%). For the other illicit substances only male subjects had tested positive. (see Tables 11 and 12).

Table 11. Distribution of substance groups by gender and age (Male)

	18-24	25-34	35-49	50+
Negative	50 (64.94%)	46 (70.77%)	49 (70.0%)	28 (65.12%)
Amphetamines	0	0	1 (1.43%)	0
Cocaine	0	1 (1.54%)	0	1 (2.33%)
THC	0	0	1 (1.43%)	0
Benzodiazepines	1 (1.30%)	2 (3.08%)	1 (1.43%)	3 (6.98%)
Drugs-drugs combi	0	2 (3.08%)	1 (1.43%)	0
Medicinal opioids	8 (10.40%)	3 (4.62%)	3 (4.29%)	6 (13.95%)
Alcohol	17 (22.08%)	9 (13.85%)	11 (15.71%)	5 (11.63%)
Alcohol+drugs	1 (1.30%)	2 (3.08%)	3 (4.29%)	0
Total	77 (100%)	65 (100%)	70 (100%)	43 (100%)

Table 12. Distribution of substance groups by gender and age (Female)

	18-24	25-34	35-49	50+
Negative	29 (76.32%)	34 (80.95%)	29 (70.73%)	15 (100%)
Amphetamines	0	0	0	0
Cocaine	0	0	0	0
THC	0	0	0	0
Benzodiazepines	1 (2.63%)	2 (4.76%)	0	0
Drugs-drugs combi	0	0	0	0
Medicinal opioids and opioids	0	1 (2.38%)	2 (4.88%)	0
Alcohol	8 (21.05%)	4 (9.52%)	7 (17.07%)	0
Alcohol+drugs	0	1 (2.38%)	3 (7.32%)	0
Total	38 (100%)	42 (100%)	41 (100%)	15 (100%)

5.3.4 Distribution of substance groups by accident type

Table 13 presents the distribution of substance groups by single-vehicle and multi-part accidents. No significant diference was found in prevalence of benzodiazepines, medicinal opioids and alcohol-drug combination. More positive findings for alcohol were observed in drivers involved in single-vehicle accidents. Amphetamines and cocaine were only found in drivers involved in multi-part collisions, while cocaine only in single-vehicle accidents. It has to be noted that these last three substances were each found positive in only one case. (see Table 13).

Table 13. Distribution of substance groups by single-vehicle accidents vs multipart accidents

	Single-vehicle	Multi-part
Negative	87 (66.92%)	209 (74.91%)
Amphetamines	0	1 (0.36%)
Cocaine	1 (0.77%)	0
THC	0	1 (0.36%)
Benzodiazepines	4 (3.08%)	7 (2.51%)
Drugs-drugs combi	0	4 (1.43%)
Medicinal opioids and opioids	6 (4.62%)	17 (6.09%)
Alcohol	28 (21.54%)	33 (11.83%)
Alcohol+drugs	4 (3.08%)	7 (2.51%)
Total	130 (100%)	279 (100%)

5.3.5 Results for additional substances:

In Lithuania, the following additional substances were detected in the collected blood samples: Tramadol – 13, Metamizol (NSAID) – 3, Midazolam (BZD) – 1, Diphenhydramine (AHD) – 1, Ketolgan (NSAID) – 1.

Table 14. Additional substances in injured drivers

Substances present	No. of cases
Tramadol	13
Metamizol (NSAID)	3
Midazolam (BZD)	1
Diphenhydramine (AHD)	1
Ketolgan (NSAID)	1

5.3.6 Distribution of substance concentrations

The range of concentration level for core DRUID substances found during the hospital survey in Lithuania are shown in table 15. The range level of ethanol was from 0.11 till 3.26 g/L (see Table 15).

Table 15. Distribution of substance concentrations

Substance	Whole blood analytical cut-off (ng/mL)	Number of cases	Range of level (ng/mL)
Ethanol	0.1 g/L	74	0.11-3.26
6-acetylmorphine	10	0	-
Alprazolam	10	1	0-54
Amphetamine	20	2	20-42
Benzoylecgonine	50	2	570-882
Clonazepam	10	6	26-145
Cocaine	10	1	0-20
Codeine	10	1	0-24
Diazepam	20	16	11-547
Flunitrazepam	2	0	-
Lorazepam	10	1	0-23
MDA	20	0	-
MDEA	20	0	-
MDMA	20	0	-
Methadone	10	1	0-152
Methamphetamine	20	2	160-240
Morphine	10	20	11-898
Nordiazepam	20	8	18-144
Oxazepam	50	0	-
THC	1	2	1.92-2.26
THCCOOH	5	4	6.5-72
Zolpidem	20	0	-
Zopiclone	10	1	0-29

5.4 Discussion of results

All Lithuanian hospital survey samples were collected in Vilnius, Kaunas, Klaipeda and Alytus research regions, which were the main sample collection research areas in the roadside survey. National data were collected from 1stof April 2008 until 20th of March 2010 to assess the situation in the country regarding the prevalence of alcohol and other psychoactive substances in accident involved drivers. The research areas of Lithuania were based on the geographical distribution of population over the country, accounting for 3,350 mln. inhabitants in total. The data were available on the injured drivers distribution by the type of vehicle, the quarter of the year, gender, age. The hospital survey area covers the whole of Lithuania and the representativeness of the sample is good since all injured drivers were included. During the survey period the total number of injured drivers involved in the hospital study was 424 drivers. The total number of collected blood samples and investigated in TMI Toxicology laboratory were 424. All data collected from the injured drivers and the toxicology analyses data were filled in a database and the database was sent to DTU and UGent on the 10th of May 2010. During the hospital study there was no one non-response or refuse. The response rate (RR) was 100%.

During the hospital survey in Lithuania most of the injured drivers were from urban road type – 98% and from Kaunas research region – 84 % which is in urban area of Lithuania in cross connection with main urban roads. The larger number of injured drivers was in the daytime hours which caused by the much higher traffic volumes during day time hours than during the night time. No big difference was found in the distribution of injured drivers by quarters. The majority of the injured drivers – 94 % had a MAIS 3. In the male group the number of injured drivers was higher than in the female group, no big significant difference found in distribution by age groups both in males and females from age 18 till age 50. The higher percentage of injured drivers was in personal car drivers group – 85 %, most of the injured drivers had a multi-part accident.

The toxicology results of the injured drivers show that 307 (72.41%) drivers were negative for investigated DRUID core substances. Only one driver was positive for amphetamine, two drivers were positive for cocaine, one driver was positive for THC, 11 drivers were positive for benzodiazepines. The drugs-drugs combination was found in 4 drivers, the medicinal opioids and opiodes was found in 24 drivers.

At last 63 (14.86%) injured drivers were positive for alcohol and 11 (2.59%) drivers for the combination alcohol and drugs. The highest substance prevalence in injured drivers was found in weekend night period. Alcohol was prevalent in all time periods. the highest percentage of drivers tested positive for alcohol was found in the male age group 18-24. The combination alcohol-drug was found most in the age group 35-49 for both gender. The range level of ethanol was from 0.11 till 3.26 ng/mL. In male drivers the medicinal opioids were most prevalent in the age group 50+ followed by the group 18-24 while in female drivers this substance group was only found in the age groups 25-34 and 35-49. In the male subpopulation the highest percentage of positive findings for benzodiazepines was observed in the age group 50+, in the female group this percentage was found in the age group 25-34. Only injured male drivers were positive for other illicit drugs. No significant diference was found in prevalence of benzodiazepines, medicinal opioids and alcohol-drug combination. More positive findings for alcohol were observed in drivers involved in single-vehicle accidents.

5.5 Acknowledgements

The hospital study in Lithuania was carried out in close cooperation with the administration and medical staff of the main hospitals in the following research areas of Lithuania – in Vilnius, Kaunas, Klaipeda and Alytus. The authors are grateful to the hospital staff and executive personnel for their dedication to make the survey a success. Besides we want to express our gratitude for the TMI Toxicology Laboratory staff was the collected blood samples were analysed.

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5.7 **Annex 1**

Validation data (reproducibility)

Compound	Calibration points, ng/mL	Avg. ng/mL	RSD, %	Bias, %	LOD, ng/mL	LOQ, ng/mL
Diazepam	0;10;20;30;50;70;100;120	10.34 /49.7/ 101.11	10.83 /4.67/ 4.48	3.4 /-0.6/ 1.11	1.4	4.2
Flunitrazepam	0;10;20;30;50;70;100;120	11.8 /49.26/ 103.4	9.92 /10.90/ 4.46	18 /-1.5/ 3.4	1.2	3.6
Oxazepam	0;10;20;30;50;70;100;120	10.93 /51.3/ 102.22	14.36 /5.54/ 7.15	9.3 /2.6/ 2.22	3.2	9.8
Lorazepam	0;10;20;30;50;70;100;120	11.73 /50.4/ 102.91	14.66 /7.90/ 9.37	17.3 /0.8/ 2.91	2.3	7.0
Alprazolam	0;10;20;30;50;70;100;120	12.38 /51.64/ 102.67	5.25 /4.45/ 5.07	23.8 /3.3/ 2.67	2.6	7.9
Zopiclone	0;10;20;30;50;70;100;120	- /49.16/ 104.19	- /16.97/ 18.47	- /-1.7/ 4.19	6.1	18.4
Nordazepam	0;10;20;30;50;70;100;120	9.32 /49.65/ 103.31	13.63 /9.73/ 10.75	-6.8 /-0.7/ 3.31	1.8	5.5
7-amino-clonazepam	0;10;20;30;50;70;100;120	12.85 /51.8/ 95.43	22.18 /8.55/ 8.79	28.5 /3.6/ -4.57	3.8	11.4
Clonazepam	0;10;20;30;50;70;100;120	11.87 /52.89/ 101.52	15.25 /7.83/ 11.14	18.7 /5.8/ 1.52	1.7	5.0
Amphetamine	0;20;50;100;150;200;250;300	23.60/143.07/288.13	14.58/2.40/1.92	18/-5/-4	4.2	12.7
Methamphetamine	0;20;50;100;150;200;250;300	21.93/139.26/289.14	7.48/4.72/4.05	10/-7/-4	5.24	15.9
MDA	0;20;50;100;150;200;250;300	20.44/141.32/285.23	10.71/2.05/6.25	2/-6/-5	2.65	8.02
MDMA	0;20;50;100;150;200;250;300	21.63/133.58/277.62	3.24/1.91/1.61	8/-11/-7	2.33	7.1
MDEA	0;20;50;100;150;200;250;300	22.68/136.7/280.33	1.59/2.44/1.5	13/-9/-7	1.78	5.39
THC	0;2;4;6;8;10;12;14	-/9.58/14.58	-/3.44/2.47	19.75/4.1	0.84	2.54
THC-OH	0;2;4;6;8;10;12;14	2.08/8.61/13.70	4.33/3.14/14.45	4/7.63/-2.14	0.52	1.56
THC-COOH	0;10;20;30;40;50;60;70	11.04/46.06/63.55	5.34/3.34/10.95	10.4/15.5/-9.21	2.39	7.15
ME	0;10;20;30;40;50;60;70	-/35.93/59.18	-/6.74/14.26	-/-10.17/-15.46	4.56	13.82
Cocaine	0;10;20;30;40;50;60;70	10.42/39.2/69.92	9.69/4.69/3.7	4.2/-2/-0.11	3.71	11.25
BE	0;50;100;150;200;250;300;350	50.24/184.46/326.3	4.48/6.3/3.85	0.48/-7.77/-6.77	7.95	24.08
Diphenhydramine	0;10;25;50;100;150;200;250	112.87/221.77	11.32/21.31	12.87/-11.29	7.11	21.55
Tramadol	0;10;25;50;100;150;200;250	94.92/193.81	9.17/6.28	-5.08/-22.48	3.95	11.98
Methadone	0;10;25;50;100;150;200;250	8.94/96.86/198.04	14.32/2.97/8.12	-10.6/-3.14/-20.78	3.21	9.72
Codeine	0;10;25;50;100;150;200;250	10.79/99.36/251/83	1.76/2.21/3.37	7.9/-0.64/0.73	1.8	5.44
Morphine	0;10;25;50;100;150;200;250	-/104.9/217.17	-/12.4/3.58	-/4.9/-13.13	5.01	15.18
6MAM	0;10;25;50;100;150;200;250	10.94/95.14/248.02	4.94/1.32/3.12	9.4/-4.86/0.79	2.78	8.42
Buprenorphine	0;10;25;50;100;150;200;250	87/7/266.05	13.61/5.59	-12.3/6.42	5.22	15.82

6 Country Report the Netherlands

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6.1 Introduction

The hospital survey in the Netherlands was performed according to the DRUID "Guidelines for Hospital surveys" (see Annex 1 of the Summary Report), with some minor deviations which will be highlighted in the following paragraphs.

The first objective of the hospital survey was to gain insight into the prevalence of psychoactive substances among injured drivers in the Netherlands. A second objective was to collect case data for a case-control study aimed at assessing the risk of driving under the influence of psychoactive substances.

6.2 Geographical distribution

Hospitals in the cities of Enschede, Nijmegen and Tilburg participated in the DRUID case-control study and collected accident and demographic data plus blood samples from seriously injured drivers who were admitted to the hospitals' Emergency Departments.

Figure 1 presents the geographical location of the three hospitals that participated.

Figure 1. Participating hospitals and surrounding research areas of the roadside survey in the Netherlands

6.3 Distribution of the injured drivers

6.3.1 Distribution by time period

Approximately 60% of all included patients were injured during daytime hours (4 AM-10PM). The high proportion of injured drivers during daytime hours can be explained by the traffic volumes that are much higher during daytime hours than during night time hours.

Table 1. Distribution injured drivers by time period (n=186).

Time period	
Weekday 04:00-22:00	48.4%
Weeknight 22:00-04:00	24.7%
Weekend day 04:00-22:00	11.8%
Weekend night 22:00-04:00	15.1%

6.3.2 Distribution by quarter of the year

During the 3rd quarter of the year the proportion of injured drivers is lower (although not significant, p = 0.30) than during the other three quarters. This lower proportion coincides with the summer holiday period, when traffic volumes are significantly reduced.

Table 2. Distribution of injured drivers by quarter of the year (n=186).

Quarter of the year	
1st quarter (Jan-Mar)	28.0%
2nd quarter (Apr-Jun)	24.7%
3rd quarter (Jul-Sep)	19.3%
4th quarter (Okt-Dec)	28.0%

6.3.3 Distribution by road type

In the Netherlands, the road type where accidents happened could not reliably be recorded.

6.3.4 Distribution by injury severity

The Maximum Abbreviated Injury Scale (MAIS) was used to classify the severity of injury. Injured drivers with a MAIS of 2 or higher were included.

Almost half of the included drivers had a MAIS 2 injury score. The percentage of drivers decreased with increasing MAIS: 35.7% of the injured drivers had MAIS 3; 8.7% had MAIS 4; and finally, 7.0% had MAIS 5. Killed drivers were not included in this study.

Table 3. Distribution of injured drivers by MAIS scale (n=185); missing data for 1 driver.

MAIS	
MAIS 2	48.6%
MAIS 3	35.7%
MAIS 4	8.7%
MAIS 5	7.0%

6.3.5 Distribution by gender and age

80% of the injured drivers were males. The percentage of males was the highest among the age group 18-24 years (89.6%). Among the other age groups the percentage of males varied between 75% and 77%. The number of injured drivers was higher in the age groups 18-24 and 25-34, which account for 56.6% of the sample. In the older age groups the percentage decreased to 24.5% and 18.9%, respectively.

Table 4. Distribution of injured drivers by gender and age (n=186).

	Male	Female	Total
18-24 years old	90.9%	9.1%	29.6%
25-34 years old	76.5%	23.5%	27.4%
35-49 years old	75.6%	24.4%	24.2%
50 years and older	74.3%	25.7%	18.8%
Total ages	80.1%	19.9%	100%

6.3.6 Distribution by seatbelt use

Seatbelt use was not recorded in 44 cases. Among the remaining 142 injured drivers more than a quarter did not wear a seatbelt.

Table 5. Distribution of injured drivers by seatbelt use (n=142); missing data for 44 drivers.

Seatbelt use	
Seatbelt used	73.9%
Seatbelt not used	26.1%

6.3.7 Distribution by hospital region

Most of the drivers included in this study were sampled at Tilburg St. Elizabeth hospital. This could be expected since in this hospital the inclusion period had been longer than in the other two hospitals. Almost a third were from Enschede Medisch Spectrum hospital, and a quarter from Nijmegen University hospital.

Table 6. Distribution of injured drivers by hospital region (n=186).

Hospital	
Tilburg	42.5%
Enschede	33.3%
Nijmegen	24.2%

6.3.8 Distribution by type of crash

Information on type of crash was available for 168 injured drivers. Of these, almost twothird were involved in a single-vehicle crash.

Table 7. Distribution of injured drivers by type of crash (n=160); missing data for 26 drivers.

Type of crash	
Single-vehicle crash	63.1%
Multi-vehicle crash	36.9%

6.4 Methods

6.4.1 Ethical approval

Before the hospital survey started, the study protocol was submitted for approval to the ethical commissions of six hospitals that were invited to participate in the DRUID case-control study. Approval was granted in only three hospitals. Due to the long process for approval, the inclusion of cases could only start at the end of 2007.

6.4.2 Toxicological analysis of body fluids

Chemicals
Drugs of abuse and deuterated analogues were purchased from Cerilliant Corporation (Texas). Methanol, acetonitrile, water and formic acid (99%) were obtained in ULC/MS grade from Biosolve. Ammonium hydrogen carbonate and ammonia (25 %) were obtained in analytical grade from Merck. Acetone was obtained in picograde from Promochem.

Blood and plasma samples

Two venous blood samples were collected from each injured car driver, using glass tubes containing 20 mg sodium fluoride and 143 IU heparin sodium (BD Plymouth, UK). From one out of each pair of blood samples plasma was prepared by means of a centrifuge.

During the hospital survey, blood samples were stored in solid carbon dioxide at about -80˚C (dry ice). After transportation to the Netherlands Forensic Institute (NFI) in The Hague, blood samples were stored at -20˚C until analysis.

Sample preparation

Protein precipitation was performed after addition of deuterated analogs of the target compounds, by addition of acetone (0.75 ml) to the blood sample (0.25 ml), followed by centrifugation.

Analytical conditions

LCMS analysis was performed on a Water Acquity UPLC®-system with a Waters Quatro premier XE triple quadrupole mass spectrometer. Chromatography employed a reversed-phase UPLC ® column (BEH C-18, 100 x 2.1-mm i.d., 1.7 µm particle diameter) and a 17-min gradient elution (methanol / 10 mM ammonium bicarbonate pH 10.0, 5/95 to 95/5). The UPLC® injector was modified for on-line dilution of the injected sample to allow large injection volumes of acetone. The eluent was introduced to the electrospray source of the triple quadrupole MS instrument at a flow-rate of 500 µL/min. Molecular ions were fragmented using optimised collision-induced dissociation voltages for each compound (9 to 50 eV, positive ion mode). For each target-compound two MRM were monitored and for each deuterated internal standard one MRM was monitored.

Quality Control
The following Quality Control measures were taken:

- Internal standards (deuterated analogues of most target compounds) were used to correct for analytical variations.
- Calibration of all compounds in blood was performed every 2 months.
- Blank blood samples and control samples (spiked blood samples, prepared at the NFI as well as externally) were analysed daily.

- Shewhart cards were used for a selected number of compounds to monitor the daily performance.
- Regular participation took place in Round Robin tests.

Validation
The analytical method was fully validated for all compounds in blood. Validation included determination of linearity, accuracy, reproducibility, limit of detection (LOD) and stability. Validation of the analytical method was performed on blood samples obtained during a roadside survey (50 %) as well as on postmortem blood obtained during autopsies at the NFI (50 %), and obtained results were averaged.

Internal standards and analytical data are shown in Annex 1. Validation results are summarised in Annex 2.

Selectivity
The majority of compounds were separated chromatographically from each other during the LC run. Selectivity was assured by utilising a triple quadrupole system in MS/MS mode, in which single chromatographic peaks were observed for all SRM (Selective Ion Monitoring) transitions. Analytical data are collected in annex Table 1. No interfering compounds were present in blank blood.

Calibration
Calibration curves were prepared on eight concentration levels, numbered A to H. The calibration ranges are shown in Annex 2. The highest concentration level (A) was chosen on the basis of therapeutic and toxic concentrations in blood. The other concentrations were 50, 20, 10, 5, 2.5, 1 and 0.5 % of the highest concentration level for B to H, respectively.

Curves were created by plotting the peak area ratio of the drug to the internal standard versus the drug concentration. Most compounds were fitted linearly (weighing factor $1/x^2$), whereas six compounds were fitted quadratic as indicated in Annex 2. Correlation coefficients were > 0.99 for most compounds.

Recovery
The recovery was determined for each compound in blood on four concentration levels by comparing the response to that of standards in methanol. For most compounds, the recovery was around 100 % (data not shown).

Precision
The within-day precision was determined on concentration levels B and F by repeated analysis (n=8). All compounds showed a within-day precision of < 20 %.

Reproducibility
The between-day reproducibility was determined on concentration levels B and F by analysis on different days. In annex Table 2 results are shown on concentration level F for blood (n=8). Most compounds showed a reproducibility of < 20 %. The exception was aminonitrazepam in blood (25 %).

Accuracy
The accuracy for blood was determined using the average values obtained during the within-day precision experiments (n=8). For all compounds, the accuracy was in the range of 80-120 % on level B and F (see annex, Table 2 for results on level F), desmethylclobazam (74%) and flurazepam (78%) on level F excepted.

Limit of Detection and Limit of Quantification
The limit of detection (LOD) was defined as the lowest concentration for which the signal-to-noise ratio (S/N) was three for the main SRM. For this purpose, the lowest calibration sample (H) was diluted up to 1000 times and analysed. The results are shown in Annex 2. It should be taken in consideration that various factors may affect the LOD values, such as the recovery after precipitation, matrix suppression and LCMS system performance which may vary per analysis or series. Therefore, the reported LOD values should be regarded as indicative.
The lowest concentration of the calibration curves was considered as the limit of quantification (LOQ). Almost without exception the limit of quantitation (LOQ) for each analyte was equal to, or below, the DRUID cut offs. The only exception was codeine, however the limit of detection was still lower than the DRUID cut off.

Stability
The stability of all compounds was studied in methanol, precipitates (of blood), blood and oral fluid at different temperatures up to 8 weeks A compound was considered unstable if the concentration deviated more than 30 % from the initial concentration.

In methanol, all compounds were stable at -20 °C during 8 weeks on all concentration levels. However, chlordiazepoxide, desmethylchlordiazepoxide and demoxepam degrade after regular use. This is probably due to repeated exposure to light and room temperature.

The stability of precipitates of blood was determined during 8 weeks on two concentration levels (B and F) to investigate if samples could be re-run in case of failed analysis. For this purpose, precipitates were analysed on 7 days (day 0, 2, 4, 9, 16, 28 and 56). Samples were kept in the auto-sampler during 24 h at 10 °C and then stored at -20 °C. A control sample was stored at -20 °C on day 0 and analysed on day 56.

All compounds were stable during re-analyses during 4 weeks and most compounds up to 8 weeks. After 8 weeks, zoplicone was degraded (30 % left), whereas benzoylecgonine and aminonitrazepam showed an increase in signal. This may be explained by evaporation, which is insufficiently corrected for by the internal standard.
Stability results are summarised in Annex 3. The stability of spiked blood samples was studied on two concentration levels (B and F) during 8 weeks at -20 °C, during 1 month at 4-8 °C and during 1 week at 20 °C.

At -20 °C, all compounds were stable in blood during 8 weeks. At higher temperature, some compounds were unstable and started to degrade. It should be kept in mind during data interpretation that concentrations of the unstable compounds THC, THC-OH, zopiclone and desmethylchlordiazepoxide may have been higher at the moment of blood sampling than at the moment of analysis.

6.4.3 Method of BAC-quantification

Blood alcohol concentrations were determined by the NFI by using the enzymatic "alcohol dehydrogenase" method, after vapour micro-diffusion (Neuteboom et al., 1980).

6.4.4 Other collected data

Apart from the blood sampling, additional information was gathered for each subject on: gender, age, self-reported drug use, type of vehicle, crash type, injury severity, time of the accident, and administered medicinal drugs.

6.4.5 Statistical analysis

Descriptive statistics were used to calculate prevalence figures of psychoactive substances for the injured drivers.

6.5 Non-response

In the Netherlands, the ethical commissions did not require informed consent by the patients, since blood specimens had to be collected anonymously and no extra medical acts were needed for it. Consequently, the risk of selection bias caused by refusing patients was non-existent. It is possible, however, that drug and alcohol intoxicated patients were less likely to be blood sampled than sober patients, e.g., because of aggressive behaviour or because of their entrance in the Emergency Departments during peak hours. Unfortunately, no information on this kind of non-response could be retrieved by the medical staff of the Emergency Departments.

6.6 Results

6.6.1 Substance group distribution + substance classes (alcohol, illicit and medicinal drugs)

Tables 8 and 9 show the overall substance class and substance group distribution. Approximately one third of the drivers were positive for one or more substances. Alcohol alone is the most prevalent having been detected in 25 per cent of the drivers and 4.3% of the samples was positive for alcohol in combination with other psychoactive substances. Only one drug-drug combination was detected among the injured drivers. Cocaine, illicit opiates and benzodiazepines have not been detected among the 186 included drivers, although the benzoylecgonine (a metabolite of cocaine) was detected three times: twice as a single drug and one time in combination with THC-COOH, which is a metabolite of THC. One driver among the excluded samples was positive for benzodiazepines. However, this record was excluded since the time between accident and blood sampling was 3 hours.

Table 8. Distribution of substance classes (n=186).

Substance class	Number of drivers	Proportion of drivers
Negative	123	66.1%
Alcohol	47	25.3%
Illicit drugs	5	2.7%
Medicinal drugs	2	1.1%
Drug-alcohol combination	8	4.3%
Drug-drug combination	1	0.5%
Total	186	100.00%

Table 9. Distribution of substance groups.

Type	Substance group	Number of drivers	Proportion of drivers
	Negative	123	66.1%
Alcohol	Alcohol	47	25.3%
Illicit drugs	Amphetamines	2	1.1%
	Benzoylegonine	2	1.1%
	Cocaine	--	--
	THC	1	0.5%
	Illicit opiates	--	--
Medicinal drugs	Benzodiazepines	--	--
	Z-drugs	1	0.5%
	Opiates and opioids	1	0.5%
Combinations	Drug-alcohol combination	8	4.3%
	Drug-drug combination	1	0.5%
Total		186	100.00%

6.6.2 Distribution of substance groups by DRUID time periods aggregated into day (1-3 & 5-7) vs night (4&8), week (1-4) vs WE (5-8)

The distribution of substance classes by time period shows that substance prevalence in injured drivers was lowest on weekdays during daytime hours (04 AM -10 PM) with around 20% positive drivers. For the other time periods the prevalence of alcohol and drugs was double during weeknights and weekend days. In weekend nights the prevalence was even triple (62%) as compared to weekdays.

Alcohol was most prevalent in all time periods, but there was no large difference in prevalence between weekdays (34.8%), weekend days (40.9%) and weekend nights (39.3%) ($p = 0.97$).

Single drug prevalence was highest in weekend nights. Cocaine was most prevalent among injured drivers in the weekend both during daytime and night time hours. The number of samples is very low though. Therefore, these results should be taken very cautiously.

Table 10. Distribution of substance classes by time period.

Type	Substance class	Weekday (n=90)	Weeknight (n=46)	Weekend day (n=22)	Weekend night (n=28)
	Negative	81.1%	58.7%	54.6%	39.3%
Alcohol	Alcohol	12.2%	34.8%	40.9%	39.3%
Illicit drugs	Amphetamines	1.1%	--	--	3.6%
	Benzoylegonine	1.1%	--	4.6%	--
	Cocaine	--	--	--	--
	THC	--	--	--	3.6%
	Illicit Opiates	--	--	--	--
Medicinal drugs	Benzodiazepines	--	--	--	--
	Z-drugs	1.1%	--	--	--
	Opiates and opioids	1.1%	--	--	--
Combinations	Drug-alcohol combi	2.2%	6.5%	--	10.7%
	Drug-drug combi	--	--	--	3.6%
Total		100.00%	100.00%	100.00%	100.00%

6.6.3 Distribution of substance groups by gender and age

The prevalence of psychoactive substances in total differs significantly over the four age classes among male drivers (p = 0.03). Alcohol and illicit drugs were most prevalent among seriously injured male drivers between 25 and 35 years old. The combination of drugs and alcohol was most prevalent among seriously injured drivers younger than 35. Medicinal drugs was only detected among male injured drivers aged 35 and older. The number of samples is very low and any disaggregated results should be dealed with care.

Table 11. Distribution of substance classes by age for male drivers.

Type	Substance class	18-24 years (n=50)	25-34 years (n=39)	35-49 years (n=34)	≥50 years (n=26)
	Negative	68.0%	41.0%	64.7%	73.1%
Alcohol	Alcohol	26.0%	41.0%	26.5%	23.1%
Illicit drugs	Amphetamines	--	2.6%	--	--
	Benzoylegonine	--	2.6%	5.9%	--
	Cocaine	--	--	--	--
	THC	--	2.6%	--	--
	Illicit Opiates	--	--	--	--
Medicinal drugs	Benzodiazepines	--	--	--	--
	Z-drugs	--	--	--	3.9%
	Opiates and opioids	--	--	2.9%	--
Combinations	Drug-alcohol combi	6.0%	10.3%	--	--
	Drug-drug combi	--	2.6%	--	--
Total		100.00%	100.00%	100.00%	100.00%

For female injured drivers alcohol was only present from 25 years and over. Among the five young female injured drivers (18-24 years) no psychoactive substances were detected. Only women in the age group 25-34 were positive for illicit drugs. One woman was positive for amphetamines and one was positive for the combination cocaine-alcohol. The number of injured females per age group was very low, so none of the findings were significant.

Table 12. Distribution of substance classes by age for female drivers.

Type	Substance class	18-24 years (n=5)	25-34 years (n=12)	35-49 years (n=11)	≥50 years (n=9)
	Negative	100.0%	75.0%	90.9%	88.9%
Alcohol	Alcohol	--	8.33%	9.1%	11.1%
Illicit drugs	Amphetamines	--	8.33%	--	--
	Benzoylegonine	--	--	--	--
	Cocaine	--	--	--	--
	THC	--	--	--	--
	Illicit Opiates	--	--	--	--
Medicinal drugs	Benzodiazepines	--	--	--	--
	Z-drugs	--	--	--	--
	Opiates and opioids	--	--	--	--
Combinations	Drug-alcohol combi	--	8.33%	--	--
	Drug-drug combi	--	--	--	--
Total		100.00%	100.00%	100.00%	100.00%

6.6.4 Distribution of substance groups by accident type

Table 13 shows the distribution of substance classes by accident type. Psychoactive substances were significantly (p = 0.003) more prevalent in single-vehicle accidents than in multi-vehicle accidents. This is in line with other findings in literature (Gjerde et al., 1993; Hasselberg & Laflamme, 2009)

Table 13. Distribution of substance classes by accident type (missing data for 26 drivers).

Type	Substance class	Single-vehicle accident (n=101)	Multi-vehicle accident (n=59)
	Negative	62.4%	84.8%
Alcohol	Alcohol	29.7%	8.5%
Illicit drugs	Amphetamines	--	1.7%
	Benzoylegonine	1.0%	1.7%
	Cocaine	--	--
	THC	1.0%	--
	Illicit Opiates	--	--
Medicinal drugs	Benzodiazepines	--	--
	Z-drugs	--	1.7%
	Opiates and opioids	--	1.7%
Combinations	Drug-alcohol combination	5.0%	--
	Drug-drug combination	1.0%	--
Total		100.00%	100.00%

6.6.5 Distribution of substance concentrations

Substance concentrations are shown for all positive results from the 186 drivers. Minimum, maximum and median concentrations are shown for all single substances.

Table 14. Substance concentrations for substances. Minimum, maximum and median concentrations are shown.

Substance	Number of observations	Min	Max	Median
Alcohol	59	0.06 g/L	2.82 g/L	1.42 g/L
Benzoylecgonine	9	109.1 ng/mL	1500 ng/mL	763.4 ng/mL
Cocaine	5	8.9 ng/mL	208.9 ng/mL	68.3 ng/mL
MDMA	2	29.3 ng/mL	93.9 ng/mL	61.6 ng/mL
Amphetamine	2	48 ng/mL	208.7 ng/mL	128.4 ng/mL
THC	1	19.7 ng/mL	19.7 ng/mL	19.7 ng/mL
Zolpidem	1	41.6 ng/mL	41.6 ng/mL	41.6 ng/mL
MDA	1	12.6 ng/mL	12.6 ng/mL	12.6 ng/mL
Morphine	1	77.9 ng/mL	77.9 ng/mL	77.9 ng/mL

Most substances were present in only one or two injured drivers. Only alcohol, cocaine and benzoylecgonine were found in 5 or more injured drivers. The median of alcohol is quite high. 95% of the injured drivers who were positive for alcohol (BAC 0.1 g/L or higher) had a BAC above the legal limit (0.5 g/L). 57% of the injured alcohol positive drivers even had a BAC above the 1.3 g/L.

6.6.6 6.6.6 Distribution of additional substances

In the Netherlands Gamma Hudroxy Butyrate (GHB) was analysed in addition to the DRUID core substances. In total 180 serum samples have been analysed by the laboratory of the department of Clinical chmistry, microbiology and immunology of Ghent university. In this subset five samples (2.8%) were positive for GHB with concentrations ranging from 42 to 424 ng/ml. One of these samples was positive as well for amphetamines.

6.7 Discussion

The study area covers only the South and Eastern part of the Netherlands, but not the North and Western part. A recently conducted roadside survey (Houwing et al., 2011) showed no large differences between the prevalence of psychoactive substances in the four parts of the Netherlands. Based on this distribution, the expected bias from the covered area was small.

No informed consent was needed to collect a blood sample from injured drivers in the Netherlands. Therefore, the risk of selection bias caused by refusing patients was non-existent. It is possible, however, that drug and alcohol intoxicated patients were less likely to be blood sampled than sober patients, e.g., because of aggressive behaviour or because of their entrance in the Emergency Departments during peak hours. Unfortunately, no general information on this kind of non-response could be retrieved by the medical staff of the Emergency Departments.

The results show that alcohol is by far the most prevalent substance among seriously injured drivers, followed by the combination of alcohol and drugs. 58% of all alcohol positive injured drivers (BAC 0.1 g/L or higher) had a very high BAC of more than 1.3 g/L.

Only one drug-drug combination and no benzodiazepines were found among the injured drivers which was a bit surprising since these were detected more frequently than single drugs in a previous hospital study which was counducted between 2000 and 2004 in the Tilburg Saint Elisabeth Hospital (Mathijssen & Houwing, 2005). This study was conducted in the framework of the European research project IMMORTAL.

When compared to the hospital data of the IMMORTAL study, the percentage of drugs is much lower in the DRUID study, whilst the percentage of alcohol is higher. It is difficult to draw conclusions on the difference in prevalence between both studies, since chance might be an important explanatory factor, due to the low number of injured drivers in both hospital studies (respectively 184 injured drivers in the IMMORTAL study and 186 in this DRUID study). Furthermore, in the IMMORTAL study both urine and blood samples were taken, whereas in this hospital study only blood samples were used. The use of different body fluid samples makes it hard to compare the prevalence rates of both studies.

6.8 Acknowledgements

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6.10 Annex 1

Internal standards, protonated molecules [M+H]+, monitored fragments, retention times (RT), and collision energies (CE) of the drugs of abuse in the order of retention time

Analyte	Internal standaard	RT	$[M+H]^+$	CV	Fragm. 1	CE 1 (eV)	Fragm. 2	CE 2 (eV)
		min	*m/z*	*(V)*	*m/z*		*m/z*	
Benzoylecgonine	Methylecgonine-d3	3.3	290.2	25	168.1	20	105	30
Methylecgonine	Methylecgonine-d3	3.4	200.2	25	182.2	20	81.9	25
7-Aminonitrazepam	7-aminoclonazepam-d4	3.5	252.1	35	121.1	25	93.9	40
Aminoclonazepam	7-aminoclonazepam-d4	3.6	286.1	30	121.1	30	222.3	25
7-Acetamidonitrazepam	7-aminoflunitrazepam-d7	3.7	294.2	30	207.2	25	121	35
Aminoflunitrazepam	7-aminoflunitrazepam-d7	3.8	284.2	35	135.2	25	240.2	30
Acetamidoclonazepam	7-aminoflunitrazepam-d7	3.8	328.1	35	121.1	35	205.2	35
Morphine	Morfine-d3	3.9	286.2	36	165.1	40	153.1	30
MDA	MDA-d5	4.4	180.2	10	163	10	105	20
Amphetamine	Amfetamine-d8	4.6	135.9	10	119	10	90.9	15
6-MAM	6-monoacetylmorfine-d6	4.8	328.2	35	165.1	35	211.2	25
MDMA	MDMA-d5	5.1	194.2	15	163.1	15	105	25
Desmethylflunitrazepam	Desmethylflunitrazepam-d4	5.2	300.2	35	254.2	25	198.2	40
Demoxepam	Desmethylflunitrazepam-d4	5.4	287.2	35	180	20	105	20
Codeine	Codeine-d3	5.4	300.3	35	215.3	25	165.1	30
Bromazepam	Desmethylflunitrazepam-d4	5.4	316.1	30	182.2	35	209.2	25
Metamphetamine	Methylamfetamine-d8	5.5	150	15	91	15	119.1	10
Nitrazepam	Nitrazepam-d5	5.6	282.1	25	236.2	25	180.2	35
Zopiclone	Nitrazepam-d5	5.7	389	15	245.2	20	217.2	35
Clonazepam	Nitrazepam-d5	5.8	316.1	35	270.2	25	214.2	35
Desmethylclobazam	Nitrazepam-d5	6.1	287.2	25	245.2	20	210.2	35
MDEA	MDEA-d5	6.1	208.3	15	163.1	15	105	25
Flunitrazepam	Flunitrazepam-d7	6.2	314.2	30	268.3	25	239.2	35
Alpha-hydroxytriazolam	Alpha-hydroxytriazolam-d4	6.7	359	35	176.1	25	250.2	25
Alpha-hydroxy-alprazolam	Alpha-hydroxyalprazolam-d5	6.9	325.1	30	243.3	35	279.2	20
Clobazam	Oxazepam-d5	7.3	301.2	25	259.2	20	224.2	35

Desmethylchlorodiazepoxide	Oxazepam-d5	7.4	286.2	25	227.2	25	192.2	35
Oxazepam	Oxazepam-d5	7.5	287.2	25	241.2	25	104	35
Lorazepam	Lorazepam-d4	7.8	321.1	25	275.2	25	229.2	35
Hydroxy-ethyl-flurazepam	Hydroxy-ethyl-flurazepam-d4	8	333.1	30	109	25	211.2	35
Alprazolam	Alprazolam-d5	8.4	309.3	35	281.3	25	274.2	25
Zolpidem	Zolpidem-d6	8.4	308.3	35	235.3	35	263.2	25
Triazolam	Triazolam-d4	8.7	343	35	239.2	40	111.1	50
Desalkylflurazepam	Desalkylflurazepam-d4	8.8	289.2	35	140	30	226.2	30
Temazepam	Temazepam-d5	8.9	301.2	20	255.2	20	177.1	35
Alpha-hydroxymidazolam	Desmethyldiazepam-d5	9.9	342.1	30	203.3	25	168.1	40
Chlordiazepoxide	Desmethyldiazepam-d5	9.9	300.2	20	227.2	25	165.1	45
Brotizolam	Desmethyldiazepam-d5	10	394.8	35	314.1	25	316.2	25
Lormetazepam	Desmethyldiazepam-d5	10.1	335	20	289.2	20	177.1	40
Desmethyldiazepam	Desmethyldiazepam-d5	10.8	271.2	35	140	25	165	25
Cocaine	Cocaine-d3	11.4	304.2	25	182.2	20	105	35
Diazepam	Desmethyldiazepam-d5	11.6	285.2	30	154	25	193.2	30
Midazolam	Desmethyldiazepam-d5	11.8	326.2	35	244.2	25	291.3	25
THC-COOH	11-nor-9-carboxy-delta9-THC-d9	12.1	345.2	25	299.4	20	327.3	15
Flurazepam	Desalkylflurazepam-d4	12.6	388.1	25	315.2	25	288.3	25
Methadone	Methadone-d9	13.1	310.3	20	265.3	15	105	25
11-OH-THC	11-hydroxy-delta 9-THC-d3	13.2	331.3	20	193.4	25	313.3	15
THC	Delta 9-THC-d3	15.3	315.3	25	193.2	20	259.5	30

6.11 **Annex 2**

Validation results of drugs of abuse in blood. Analytes are shown in the order of retention time.

Analyte	Calibration range (mg/L) *	Correlation coefficient (R^2) **	Reproducibility (%) ***	Accuracy (%) ***	LOD (µg/L)	LOQ (µg/L)
Benzoylecgonine	0.015-3.0	1.000 (2^{nd})	6	117	0.1	15
Methylecgonine	0.005-1.0	0.999	5	101	0.02	5
7-Aminonitrazepam	0.001-0.2	0.999	25	110	0.2	1
Aminoclonazepam	0.001-0.2	0.999	11	110	0.02	1
7-Acetamidonitrazepam	0.001-0.2	0.999	8	91	0.03	1
Aminoflunitrazepam	0.001-0.2	0.999	10	94	0.1	1
Acetamidoclonazepam	0.001-0.2	0.999	8	95	0.02	2
Morphine	0.005-1.0	0.999	6	96	0.1	5
MDA	0.01-2.0	0.999	5	101	0.1	10
Amphetamine	0.01-2.0	0.999	16	95	0.1	10
6-MAM	0.002-0.4	0.999	7	92	0.02	2
MDMA	0.01-2.0	1.000 (2^{nd})	4	102	0.1	10
Desmethylflunitrazepam	0.001-0.2	0.999	13	93	0.02	1
Demoxepam	0.01-2.0	0.999 (2^{nd})	18	118	0.1	20
Codeine	0.02-4.0	0.999 (2^{nd})	6	103	0.2	20
Bromazepam	0.002-0.4	0.999	12	89	0.1	2
Metamphetamine	0.005-1.0	0.999	10	91	0.1	5
Nitrazepam	0.002-0.4	0.999	17	87	0.01	2
Zopiclone	0.004-0.8	0.999	10	100	0.03	4
Clonazepam	0.001-0.2	0.999	11	96	0.04	1
Desmethylclobazam	0.005-1.0	0.995	10	74	0.04	5
MDEA	0.005-1.0	0.999	5	91	0.03	5
Flunitrazepam	0.001-0.2	0.999	15	99	0.02	1
Alpha-hydroxytriazolam	0.001-0.2	0.999	10	97	0.01	1
Alpha-hydroxy-alprazolam	0.001-0.2	0.999	19	96	0.05	5
Clobazam	0.005-1.0	0.999	5	106	0.02	5
Desmethylchlorodiazepoxide	0.008-1.6	0.999	9	102	0.3	8
Oxazepam	0.01-2.0	0.999	5	96	0.1	10
Lorazepam	0.002-0.4	1.000 (2^{nd})	7	112	0.1	4
Hydroxy-ethyl-flurazepam	0.002-0.4	0.999	6	90	0.1	2
Alprazolam	0.001-0.2	0.999	6	93	0.01	1
Zolpidem	0.003-0.6	0.999	4	96	0.02	3
Triazolam	0.001-0.2	0.999	7	107	0.03	1
Desalkylflurazepam	0.002-0.4	0.999	7	95	0.01	2
Temazepam	0.01-2.0	0.999	5	94	0.04	10
Alpha-hydroxymidazolam	0.001-0.2	0.999	4	99	0.03	1
Chlorediazepoxide	0.01-2.0	0.999	5	93	0.1	10
Brotizolam	0.001-0.2	0.999	6	107	0.01	1
Lormetazepam	0.001-0.2	0.995	6	94	0.02	1
Desmethyldiazepam	0.005-1.0	0.999	7	104	0.1	5
Cocaine	0.005-1.0	0.999	5	106	0.04	5
Diazepam	0.005-1.0	0.999	7	92	0.4	5
Midazolam	0.002-0.4	0.999	8	86	0.03	2
9-COOH-THC	0.001-0.2	0.991	9	96	0.5	1
Flurazepam	0.001-0.2	0.999	15	78	0.01	1
Methadon	0.005-1.0	0.999	11	116	0.03	5
11-OH-THC	0.001-0.2	0.999	9	98	0.4	1
THC	0.001-0.2	0.999	13	103	0.02	1

*) The LOQ is defined as the lowest concentration of the linear range.
) Linear fit except when labeled 2^{nd}: quadratic fit; *) Shown results obtained using concentration level F; ND: Not determined

6.12 **Annex 3**

Stability (in days) of compounds in blood and oral fluid on concentration levels B and F at different temperatures.

	Blood					
	20 °C	20 °C	10 °C	10 °C	-20 °C	-20 °C
	B	F	B	F	B	F
benzoylecgonine	>7	>7	>28	>28	>57	>57
methylecgonine	>2	>2	>7	>7	>57	>57
aminonitrazepam	>7	>7	>28	>28	>57	>57
aminoclonazepam	>7	>7	>28	>28	>57	>57
Acetamidonitrazepam	>7	>7	>28	>28	>57	>57
aminoflunitrazepam	>7	>7	>28	>28	>57	>57
acetamidoclonazepam	>7	>7	>28	>28	>57	>57
morphine	>7	>7	>28	>28	>57	>57
MDA	>7	>7	>28	>28	>57	>57
amphetamine	>7	>7	>28	>28	>57	>57
6-M.A.M	>2	>2	>7	>28	>57	>57
MDMA	>7	>7	>28	>28	>57	>57
desm.flunitrazepam	>7	>7	>28	>28	>57	>57
demoxepam	>7	>7	>28	>28	>57	>57
codeine	>7	>7	>28	>28	>57	>57
bromazepam	>7	>7	>28	>28	>57	>57
metamphetamine	>7	>7	>28	>28	>57	>57
nitrazepam	>7	>7	>28	>28	>57	>57
zopiclone	<2	<2	<2	<2	>57	>57
clonazepam	>7	>7	>28	>28	>57	>57
desm.clobazam	>7	>7	>28	>28	>57	>57
MDEA	>7	>7	>28	>28	>57	>57
flunitrazepam	>7	>7	>28	>28	>57	>57
OH-triazolam	>7	>7	>28	>28	>57	>57
OH-alprazolam	>7	>7	>28	>28	>57	>57
clobazam	>7	>7	>28	>28	>57	>57
desm.chloordiazepoxide	>2	>2	>7	>2	>57	>57
oxazepam	>7	>7	>28	>28	>57	>57
lorazepam	>7	>7	>28	>28	>57	>57
OH-ethylflurazepam	>7	>7	>28	>28	>57	>57
alprazolam	>7	>7	>28	>28	>57	>57
zolpidem	>7	>7	>28	>28	>57	>57
triazolam	>7	>7	>28	>28	>57	>57
desalk.flurazepam	>7	>7	>28	>28	>57	>57
temazepam	>7	>7	>28	>28	>57	>57

OH-midazolam	>7	>7	>28	>28	>57	>57
chloordiazepoxide	>7	>7	>28	>28	>57	>57
brotizolam	>7	>7	>28	>28	>57	>57
lormetazepam	>7	>7	>28	>28	>57	>57
nordiazepam	>7	>7	>28	>28	>57	>57
cocaine	>2	>2	>7	>7	>57	>57
diazepam	>7	>7	>28	>28	>57	>57
midazolam	>7	>7	>28	>28	>57	>57
COOH-THC	>7	>2	>28	>28	>57	>57
flurazepam	ND	ND	ND	ND	ND	ND
methadon	<2	>7	>28	>28	>57	>57
OH-THC	>2	<2	>2	>2	>57	>57
THC	<2	<2	>2	>2	>57	>57

Part 3 - Country reports from the studies on killed drivers

1 Country Report Finland

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1.1 Description of the killed driver sample

1.1.1 Introduction.

The aim of the survey was to form an estimate of alcohol and drug use among killed drivers in Finland. Retrospective data of all killed drivers throughout Finland for the period 2006 - 2008 were collated.

The survey data were collated in accordance with the inclusion criteria set out in the guidelines for the hospital survey (D 2.1.2).

Data concerning the accidents was collected from the Finnish Motor Insurers´ Centre (VALT). VALT is the agency that collects and holds information gathered by accident investigation teams in Finland. When toxicological analytical information for killed drivers could not be retrieved from the VALT archives the autopsy reports were requested from the Department of Forensic Medicine, Helsinki University, which performs forensic autopsies for the whole of Finland. In these instances the information for respective cases was then matched and collated to one database.

Information for all killed drivers during the survey period was available: the inclusion criteria for the survey were that all drivers were age 18 years old or over and died within 24 hours of the accident. Vehicles included were cars, vans, motorcycles, mopeds, bicycles, buses, trucks and others (e.g., quad bikes, tractors and snowmobiles). A total of 652 killed drivers and cyclists were included in the survey.

1.1.2 Geographical distribution of killed drivers over the country

Drivers killed throughout the whole of Finland (Figure 1) were included in the survey. The fraction of drivers killed in each of the roadside survey regions of Uusimaa (southern Finland) and Pohjois-Savo (central Finland) and the rest of the country are presented in Table 1.

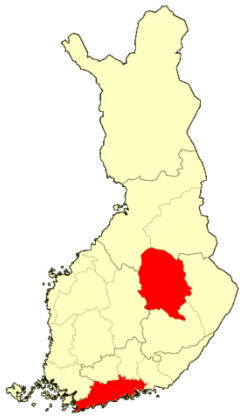

Figure 1. Finland (Uusimaa and Pohjois-Savo regions highlighted red)

Table 1. Distribution of killed drivers

Region	Fraction of killed drivers
Uusimaa	0.141
Pohjois-Savo	0.067
Rest of Finland	0.791
Total	1

1.1.3 Distributions of killed drivers

Information presented is fully comprehensive for all 652 cases included in the database unless otherwise stated.

Information on whether the fatal accident site was urban or rural was recorded in the database at VALT. The distribution of killed drivers according to road type is shown in table 2. Road type information for 109 of the killed drivers was recorded at VALT as 'neighbouring densely populated area'; these cases were interpreted as rural accidents. Road type information was missing for 11 cases.

Table 2. Distribution of killed drivers by road type

Road type	Fraction of killed drivers (n=641)
Urban	0.178
Rural	0.822
Total	1

The retrospective survey period covered three whole complete years, from the beginning of 2006 to the end of 2008. The distribution of killed drivers by season is shown in table 3.

Table 3. Distribution of killed drivers by quarter of the year

Quarter of the year	Fraction of killed drivers
First (Jan, Feb, Mar)	0.179
Second (Apr, May, Jun)	0.259
Third (Jul, Aug, Sep)	0.314
Fourth (Oct, Nov, Dec)	0.247
Total	1

The distribution of time of accident for the killed drivers in the survey according to DRUID time periods, as defined in the survey guidelines, is presented in table 4.

Table 4. Distribution of killed drivers by day of the week and time of the day

DRUID time code	Fraction of killed drivers
Weekday 4:00 to 10:00	0.156
Weekday 10:00-16:00	0.247
Weekday 16:00-22:00	0.156
Weekday 22:00-4:00	0.072
Weekend 4:00-10:00	0.064
Weekend 10:00-16:00	0.069
Weekend 16:00-22:00	0.132
Weekend 22:00-4:00	0.103
Total	1

The age and gender distribution of all killed drivers in the survey is shown in table 5. The age group classifications are as defined in the survey guidelines.

Table 5. Distribution of killed drivers by age and gender

	Killed drivers		
Age group (years)	**Male**	**Female**	**In total**
18-24	0.199	0.029	0.229
25-34	0.133	0.015	0.149
35-49	0.166	0.055	0.221
50+	0.328	0.074	0.402
Total	0.827	0.173	1

A more detailed histogram of the age-gender distribution of the survey population is presented in Figure 2.

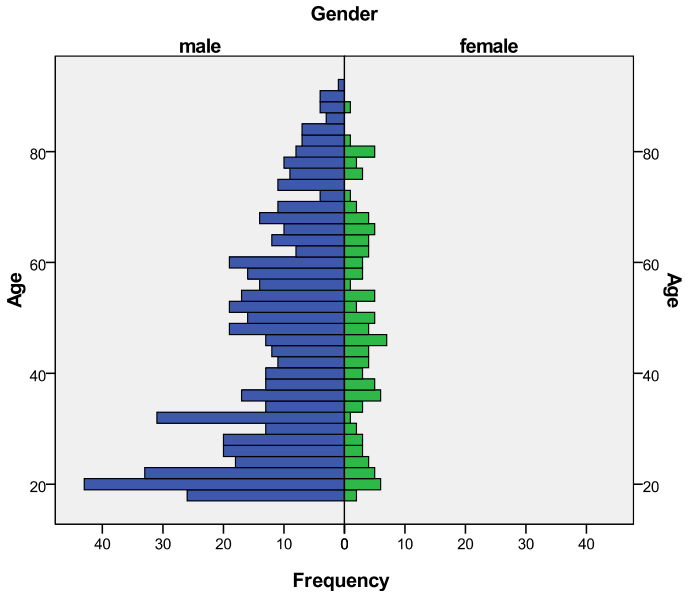

Figure 2. Age and gender distribution of killed drivers

Information on the distribution of vehicle type of the killed drivers is presented in table 6. The vehicle type for 27 killed drivers was classified as 'other', these vehicles included tractors, snowmobiles and other 3 or 4 wheel vehicles requiring a licence (e.g. quad bikes).

Table 6. Distribution of killed drivers by vehicle

Type of vehicle	Fraction of killed drivers
car	0.709
van	0.032
truck/bus	0.104
motorcycle	0.017
bicycle	0.066
moped	0.031
other	0.041
Total	1

The distribution of killed drivers according to whether the accident involved only one or multiple vehicles is shown in table 7. For multiple vehicle accidents, including those involving cyclists, 288 killed drivers out of 375 were listed as the primary or main cause of the accident. 7 of the single vehicle fatal accidents were caused by hitting an animal.

Table 7. Distribution of killed drivers by accident type

Type of accident	Fraction of killed drivers
Single vehicle	0.425
Multiple vehicle	0.575
Total	1

For 107 of the killed drivers in the survey information regarding the use of a safety belt was recorded as unknown. The distribution of the other 545 killed drivers, according to whether a safety belt was used or not, is seen in table 8.

Table 8. Distribution of killed drivers according to safety belt use

Safety belt used	Fraction of killed drivers (n =545)
Yes	0.481
No	0.519
Total	1

1.2 Methods: Data collection and analysis

1.2.1 Ethical approval

The research plan for this survey was approved by the coordinating ethical advisory board of the Hospital District of Helsinki and Uusimaa. The identities of the killed drivers were not recorded.

1.2.2 Specimen collection, time between death and sampling, site of sampling

Only drivers who died within 24 hours of the accident were included in the survey. For those cases where the date of sampling was available (n=301), the time between death and sampling varied between 0 and 288 hrs. Only analytical toxicology results for blood samples were used in this survey. Blood autopsy samples were collected from the femoral vein to a tube containing 0.1g of sodium fluoride. The final concentration of fluoride was at least 1%.

1.2.3 Toxicological analysis of body fluids

Toxicological analysis of the autopsy samples was carried out at the Department of Forensic Medicine, Helsinki University. Comprehensive screening and quantification was carried out by precise gas chromatography with retention time locking as described in (1). The DRUID cut-offs applied for positive results in this survey are listed in the Methods section of the Summary Report.

1.2.4 Other collected data

Extensive information concerning the killed drivers and place of accident was available from VALT and this information was almost fully comprehensive for all cases. The relevant variables selected for the DRUID survey are listed here:

- Gender
- Age at death
- Type(s) of motor vehicle licence held at time of death
- Year first motor vehicle licence achieved
- Type of vehicle
- Time and place of accident
- Death was instant, dead on arrival, within 6 hours or 6-24 hours of accident
- Road type
- Single or multiple vehicle accident

For 301 cases the sampling date was also obtained. The number of days from the death date to the sampling date was then multiplied by 24 to provide an estimate of the time between death and sampling in hours.

1.2.5 Statistical analysis

The data were processed with PASW (Predictive Analytics SoftWare) Statistics 17.0 by SPSS: An IBM® Company.

1.3 Non-response, refusals

1.3.1 Size and nature of non-response

The analytical toxicology results for the blood autopsy samples of 20 killed drivers were not found, although a blood alcohol result was obtained. In a further 12 cases only the blood alcohol results were not retrieved. In five cases no analytical toxicology results were retrieved for either drugs or alcohol.

1.3.2 Possible confounding effect of non-response

The percentage of cases for which toxicological analysis results are unknown or incomplete is only 5.7% and it is unlikely that there is any confounding effect from this since the reason they are missing, i.e. the autopsy reports could not be found from the Department of Forensic Medicine with the available case information, is independent of any factors involved in the fatal accidents.

1.4 Results

From the 652 killed drivers and cyclists included in the survey there were 253 cases (38.8%) with positive findings, above DRUID cut-offs, for the DRUID core substances. This increases to 272 (41.7%) if additional substances analysed in Finland are included.

Regarding the core substances, nationally the highest prevalence was for alcohol with 29.1% (190 cases) of alcohol positive cases - 23.8% (155 cases) at blood alcohol concentrations of 1.3 g/L or more, 2.9% (19 cases) between 0.8 – 1.3 g/L, 0.5% (3 cases) between 0.5 – 0.8 g/L and 2.0% (13 cases) between 0.1 – 0.5 g/L.

The prevalence of other substance classes was 12.9% for benzodiazepines and Z-drugs (84 cases: 68 with benzodiazepines only, 9 with Z-drugs only and 7 with both), 1.8% (12 cases) for both amphetamines and opioids (either illicit or medicinal) and 1.1% (7 cases) for THC.

1.4.1 Detailed substance group distribution for the area the results are applicable to

Table 9 shows the regional distribution of cases according to the types of substances detected, or combinations thereof. A relatively large proportion of cases positive for substances other than alcohol, benzodiazepines and Z-drugs can be seen for the Uusimaa region (8 cases) in comparison to Pohjois-Savo (1 case) and the rest of the country (17 cases). Alcohol and sedative type drugs appear to be more evenly distributed among the survey cases throughout Finland.

Table 9. Regional distribution of cases by substance groups detected

Substances present	Region			
	Uusimaa	Pohjois-Savo	Rest of Finland	Total
None	62	22	315	399
Amphetamines only	2	0	3	5
Benzodiazepines only	2	1	30	33
Amphetamines and benzodiazepines	2	0	0	2
Amphetamines, cannabis and	0	1	2	3
Z-drugs only	0	2	6	8
Benzodiazepines and Z-drugs	0	0	3	3
Opioids* only	3	0	6	9
Benzodiazepines and opioids*	0	0	1	1
Alcohol only	13	14	124	151
Amphetamines and alcohol	0	0	1	1
Cannabis and alcohol	1	0	2	3
Benzodiazepines and alcohol	7	4	16	27
Cannabis, benzodiazepines and alcohol	0	0	1	1
Z-drugs and alcohol	0	0	1	1
Benzodiazepines, Z-drugs and alcohol	0	0	3	3
Amphetamines, benzodiazepines, opioids*	0	0	1	1
Benzodiazepines, Z-drugs, opioids* and alcohol	0	0	1	1

*medicinal or illicit

1.4.2 Distribution of substance groups by DRUID time periods aggregated into day vs night, week vs WE

Table 10 shows the distribution of killed drivers according to whether the fatal accident occurred during the day or night. As can be seen, procentually the occurrence of accidents with no findings during the day is over double of that during the night. Most substance-positive cases occurred during day time, except for cases involving alcohol or alcohol and benzodiazepines which are more equally spread. Results are similar for the distribution over weekdays and the weekend (Table 11), although the proportion of cases occurring at the weekend is greater than for nighttime. Again alcohol and alcohol with benzodiazepines findings are more evenly distributed over weekday and weekend periods.

Table 10. Distribution by number of cases according to substance groups detected and time of day

Substances present	Time	
	Day (%)	Night (%)
None	365 (67.8)	34 (29.4)
Amphetamines only	4 (0.7)	1 (0.9)
Benzodiazepines only	31 (5.8)	2 (1.8)
Amphetamines and benzodiazepines	2 (0.4)	0 (0)
Amphetamines, cannabis and benzodiazepines	2 (0.4)	1 (0.9)
Z-drugs only	7 (1.3)	1 (0.9)
Benzodiazepines and Z-drugs	3 (0.6)	0 (0)
Opioids* only	9 (1.7)	0 (0)
Benzodiazepines and opioids*	1 (0.2)	0 (0)
Alcohol only	92 (17.1)	59 (51.8)
Amphetamines and alcohol	1 (0.2)	0 (0)
Cannabis and alcohol	2 (0.4)	1 (0.9)
Benzodiazepines and alcohol	15 (2.8)	12 (10.5)
Cannabis, benzodiazepines and alcohol	0 (0)	1 (0.9)
Z-drugs and alcohol	1 (0.2)	0 (0)
Benzodiazepines, Z-drugs and alcohol	2 (0.4)	1 (0.9)
Amphetamines, benzodiazepines, opioids* and alcohol	0 (0)	1 (0.9)
Benzodiazepines, Z-drugs, opioids* and alcohol	1 (0.2)	0 (0)
Total	538 (100)	114 (100)

*medicinal or illicit

Table 11. Distribution by number of cases according to substance groups detected and time of week

Substances present	Time	
	Weekday (%)	Weekend (%)
None	280 (68.0)	119 (49.6)
Amphetamines only	3 (0.7)	2 (0.8)
Benzodiazepines only	23 (5.6)	10 (4.2)
Amphetamines and benzodiazepines	1 (0.2)	1 (0.4)
Amphetamines, cannabis and benzodiazepines	2 (0.5)	1 (0.4)
Z-drugs only	7 (1.7)	1 (0.4)
Benzodiazepines and Z-drugs	3 (0.7)	0 (0)
Opioids* only	5 (1.2)	4 (1.7)
Benzodiazepines and opioids*	1 (0.2)	0 (0)
Alcohol only	69 (16.7)	82 (34.2)
Amphetamines and alcohol	0 (0)	1 (0.4)
Cannabis and alcohol	1 (0.2)	2 (0.8)
Benzodiazepines and alcohol	13 (3.2)	14 (5.8)
Cannabis, benzodiazepines and alcohol	0 (0)	1 (0.4)
Z-drugs and alcohol	1 (0.2)	0 (0)
Benzodiazepines, Z-drugs and alcohol	2 (0.5)	1 (0.4)
Amphetamines, benzodiazepines, opioids* and alcohol	0 (0)	1 (0.4)
Benzodiazepines, Z-drugs, opioids* and alcohol	1 (0.2)	0 (0)
Total	412 (100)	240 (100)

*medicinal or illicit

1.4.3 Distribution of substance groups by gender and age

Table 12 shows the distribution of survey cases according to substances detected and age and gender. 83% of drivers included in the survey were male and correspondingly the occurrence of drugs in women drivers was low, furthermore only one of these cases involved a substance other than alcohol or benzodiazepines (1 opioids detection, age group 50+ years). Among males occurrence of amphetamines and cannabis was more frequent among younger drivers (18 – 34 years), whereas opioids and sedative type drugs, particularly Z-drugs, were more frequent among the older drivers (35 – 50+ years). The occurrence of alcohol in male killed drivers aged 24 and under was noticeably high in comparison to the other age groups, contrastingly the corresponding 'risk' group for alcohol among women appears to be those aged between 35-49 years. Use of benzodiazepines with alcohol in fatal accidents appears to be more common for males between 25-49 years rather than the younger or older age groups.

Table 12. Distribution by number of cases according to substance groups detected and age and gender

		Age group			
Gender	**Substances present**	**18-24 (%)**	**25-34 (%)**	**35-49 (%)**	**50+ (%)**
Male	None	57	52	57	149
	Amphetamines only	2 (1.7)	2 (2.1)	0 (0)	1 (0.5)
	Benzodiazepines only	1 (0.8)	6 (6.2)	4 (3.7)	12 (5.6)
	Amphetamines and benzodiazepines	0 (0)	0 (0)	2 (1.9)	0 (0)
	Amphetamines, cannabis and	1 (0.8)	1 (1.0)	1 (0.9)	0 (0)
	Z-drugs only	1 (0.8)	0 (0)	0 (0)	7 (3.3)
	Benzodiazepines and Z-drugs	0 (0)	0 (0)	0 (0)	3 (1.4)
	Opioids* only	1 (0.8)	0 (0)	1 (0.9)	7 (3.3)
	Alcohol only	54	25	29	29
	Amphetamines and alcohol	1 (0.8)	0 (0)	0 (0)	0 (0)
	Cannabis and alcohol	0 (0)	1 (1.0)	2 (1.9)	0 (0)
	Benzodiazepines and alcohol	2 (1.7)	9 (9.3)	9 (8.3)	3 (1.4)
	Cannabis, benzodiazepines and alcohol	0 (0)	0 (0)	1 (0.9)	0 (0)
	Z-drugs and alcohol	0 (0)	0 (0)	0 (0)	1 (0.5)
	Benzodiazepines, Z-drugs and alcohol	0 (0)	1 (1.0)	0 (0)	2 (0.9)
	Amphetamines, benzodiazepines, opioids*	0 (0)	0 (0)	1 (0.9)	0 (0)
	Benzodiazepines, Z-drugs, opioids* and	0 (0)	0 (0)	1 (0.9)	0 (0)
	Total	120	97 (100)	108	214
Female	None	13	9 (75.0)	22	40
	Benzodiazepines only	2 (11.8)	0 (0)	3 (8.3)	5 (10.4)
	Benzodiazepines and opioids*	0 (0)	0 (0)	0 (0)	1 (2.1)
	Alcohol only	1 (5.9)	3 (25.0)	9 (25.0)	1 (2.1)
	Benzodiazepines and alcohol	1 (5.9)	0 (0)	2 (5.6)	1 (2.1)
	Total	17 (100)	12 (100)	36 (100)	48 (100)

*medicinal or illicit

1.4.4 Distribution of substance groups by single-vehicle accidents vs. multiple vehicles

The occurrences of single and multiple vehicle accidents included in the survey was approximately 40% and 60%. In contrast the overall occurrence of positive findings in the fatal accidents (Table 13) studied was approximately 60% for single vehicle accidents and 40% for multiple vehicle accidents.

Table 13. Distribution by number of cases according to substance groups detected according to type of accident

Substances present	Type of accident	
	Single vehicle (%)	Multiple vehicle (%)
None	130 (46.9)	269 (71.7)
Amphetamines only	3 (1.1)	2 (0.5)
Benzodiazepines only	12 (4.3)	21 (5.6)
Amphetamines and benzodiazepines	0 (0)	2 (0.5)
Amphetamines, cannabis and benzodiazepines	0 (0)	3 (0.8)
Z-drugs only	2 (0.7)	6 (1.6)
Benzodiazepines and Z-drugs	0 (0)	3 (0.8)
Opioids* only	5 (1.8)	4 (1.1)
Benzodiazepines and opioids*	0 (0)	1 (0.3)
Alcohol only	101 (36.5)	50 (13.3)
Amphetamines and alcohol	1 (0.4)	0 (0)
Cannabis and alcohol	3 (1.1)	0 (0)
Benzodiazepines and alcohol	17 (6.1)	10 (2.7)
Cannabis, benzodiazepines and alcohol	1 (0.4)	0 (0)
Z-drugs and alcohol	0 (0)	1 (0.3)
Benzodiazepines, Z-drugs and alcohol	1 (0.4)	2 (0.5)
Amphetamines, benzodiazepines, opioids* and alcohol	0 (0)	1 (0.3)
Benzodiazepines, Z-drugs, opioids* and alcohol	1 (0.4)	0 (0)
Total	277 (100)	375 (100)

*medicinal or illicit

1.4.5 Distribution of additional substances

In addition to the core substances analysed by all countries for DRUID there were substance findings (above the LOQ) for either temazepam, buprenorphine, carbamazepine, midazolam, amitriptyline, citaprolam, fluoxetine or mirtazapine in 65 cases. The distribution of these findings within the cases, according to positive detections for core DRUID substances is shown in table 14. Additional substances were also detected below the LOQ in a further 13 cases, of which seven cases were positive for core DRUID substances. There were no positive cases for carisoprodol or nitrazepam within the survey.

Table 14. Distribution of positive detections of additional substances within cases as according to core DRUID substance groups detected

Substances present	No. of cases
None	18
Amphetamines only	1
Benzodiazepines only	12
Amphetamines and benzodiazepines	1
Amphetamines, cannabis and benzodiazepines	1
Z-drugs only	1
Benzodiazepines and Z-drugs	1
Opioids* only	1
Alcohol only	11
Benzodiazepines and alcohol	13
Cannabis, benzodiazepines and alcohol	1
Z-drugs and alcohol	1
Benzodiazepines, Z-drugs and alcohol	1
Amphetamines, benzodiazepines, opioids* and alcohol	1
Benzodiazepines, Z-drugs, opioids* and alcohol	1

*medicinal or illicit

Tables 15 – 19 show the distributions of these additional substance findings according to region, time of day, time of week, age and gender and type of vehicle accident. Compared to, for example, amphetamines and cannabis, the additional substances are more evenly spread by region (table 15).

Table 15. Distribution by number of cases of additional substances by region

Region			
Uusimaa (%)	Pohjois-Savo (%)	Rest of Finland (%)	Total (%)
11 (16.9)	5 (7.7)	49 (75.4)	65 (100)

Distribution by time of day (table 16) and time of week (table 17) for additional substances are similar to those of the DRUID core substances, excepting alcohol and benzodiazepines combined with alcohol.

Table 16. Distribution by number of cases of additional substances by time of day

Time	
Day (%)	Night (%)
53 (81.5)	12 (18.5)

Table 17. Distribution by number of cases of additional substances by time of week

Time	
Weekday (%)	Weekend (%)
40 (61.5)	25 (38.5)

Distribution of additional substances by age and gender (table 18) suggests these drugs are found more commonly among older drivers (35-50+ years) for both sexes.

Table 18. Distribution by number of cases of additional substances by age and gender

Gender	Age group				
	18-24 (%)	25-34 (%)	35-49 (%)	50+ (%)	Total (%)
Male	7 (13.5)	10 (19.2)	17 (32.7)	18 (34.6)	52 (100)
Female	0 (0)	0 (0)	5 (38.5)	8 (61.5)	13 (100)

The distribution of additional substances among killed drivers (table 19) was quite equal, in fact slightly more were encountered in single vehicle accidents, which did not reflect the fact that the majority of accidents were involving multiple vehicles.

Table 19. Distribution by number of cases of additional substances by type of accident

Type of accident	
Single vehicle (%)	Multiple vehicle (%)
33 (50.8)	32 (49.2)

1.4.6 Distribution of substance concentrations

The range of concentrations encountered for each drug found and, where applicable, median concentration, are shown in table 20 for core DRUID substances and table 21 for additional substances. For substances other than those listed only concentrations between the LOD & LOQ were found; these were the core DRUID substances clonazepam (2 cases) and MDA (1 case).

Table 20. Distribution of substance concentrations for core DRUID substances

Analyte	N*	Concentration range (ng/mL)	Median concentration (ng/mL)
Ethanol	189	0.1 – 3.7 g/L	1.9 g/L
Amphetamine	10	40 - 120000	2400
Methamphetaminee	2	40, 2100	-
MDMA	3	60 - 320	300
THC	7	2.0 – 4.5	3.1
Diazepam	47	20 - 1200	100
Nordiazepam	45	20 - 1600	100
Oxazepam	29	20 - 2400	90
Alprazolam	10	20 - 100	40
Lorazepam	4	10 - 20	20
Zopiclone	11	40 - 800	100
Zolpidem	5	30 - 300	100
Morphine	2	30, 70	-
Codeine	4	20 - 70	40
Tramadol	7	200 - 800	400

* Number of positive cases above LOQ, number in parentheses are positive cases between LOD and LOQ

Table 21. Distribution of concentrations for additional substances

Analyte	N*	Concentration range (ng/mL)	Median concentration (ng/mL)
Temazepam	29	20 - 3600	70
Buprenorphine	5	0.4 - 4500	4.8
Carbamazepine	2	5800, 8000	-
Midazolam	2	30, 70	-
Amitriptyline	3	100 - 700	100
Citaprolam	20	100 - 1000	300
Fluoxetine	7	100 - 900	300
Mirtazapine	10	60 - 300	100

* Number of positive cases above LOQ, number in parentheses are positive cases between LOD and LOQ

1.5 Discussion of results

1.5.1 Representativeness

The data presented here is almost fully comprehensive for the three years 2006 to 2008. Therefore it can be assumed that these results are representative of the situation regarding killed drivers of motorised vehicles and bicycles in Finland.

1.5.2 Effects of non-response

There was no 'non-response' group and analytical toxicology results were either partially or completely missing for only a relatively small number of cases (37). For the reason stated in section 3.2 it is reasonable to assume there is no confounding effect due to any missing sample analysis data.

1.5.3 Highlights

About 28% of the Finnish population lives within the Uusimaa area, this contains the capital city Helsinki – a high proportion of fatal accidents involving illicit drugs within the survey are located in this region. Conversely, alcohol and benzodiazepines, particularly in combination with the former, are more commonly encountered throughout the rest of the country. The more even regional distribution of such cases is probably explainable by the easier availability of these substances. The distribution of these cases in terms of time (day vs. night and weekday vs. weekend) is also atypical of the distributions of cases encountered in this survey, involving other types or combinations of substances. It is notable that alcohol-only positive cases are much more common among males aged 18-24 years. In all the male age groups, and also for females aged 34-49 years, alcohol-only cases are predominant. Nonetheless, the number of these cases in the males aged 18-24 years group, which comprised almost 20% of the survey population, was almost double that in the next highest groups: males aged 30-49 years (17% of survey population) and aged 50+ years (33% of survey population). Fatal accident cases involving no detected substances were most common in the oldest age group (50+ years) for both sexes. These two groups comprised the largest proportions of the survey populations.

1.5.4 Comparison to other studies

Similarly to previous studies, male drivers are predominantly represented in this survey at a level of approximately 80% of killed drivers. Unsurprisingly, where differentiated, the majority of drivers in these studies were also of passenger cars. Alcohol was found to be a significant factor in all these studies, commonly occurring in approximately 30% of cases and frequently at relatively high BAC levels whilst the proportion of killed drivers

with no substance detections were also similar at 45-50% of cases (2-5). Both of these are findings that are comparable to the results in this survey. In the earlier studies by Seymour and Oliver (1999) and Carsten Hansen et al. (1995) alcohol was deemed to be a major causative factor in road traffic accidents while the contribution of medical drugs and narcotics was deemed to be a much lower causative factor (2, 5), again results which appear to tally with this survey. The later studies by Drummer et al. (2003) and Elliot et al. (2009) both demonstrated that, aside from alcohol, cannabinoids were the most commonly encountered drugs which contrasts markedly with this survey (3, 4). Drummer et al. also reviewed a number of fatal accident studies from different countries for which cannabis prevalence varied between 1.4-37%. Other substance groups noted in the review were cocaine 0.2-20%, benzodiazepines (or specifically diazepam) 1.4-6.3%, opioids 2.1-4.9% and amphetamines ~2% These results vary a lot depending on the country and probably also on the study design (i.e. specific driver groups included to the studies and grouping of substances). Regarding prevalence of chemical substances in single and multiple vehicle crashes, Drummer et al. also found a higher incidence of alcohol in single vehicle accidents (44.1% vs 13.7%), as seen in this survey (3).

1.6 Acknowledgements

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2 Country Report Norway

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2.1 Description of the killed driver sample

The study was performed as described in Annex 1 of the Summary Report.

Data on persons injured or killed in road traffic accidents in Norway are submitted by the police to Statistics Norway on a regular basis. These data are entered into the Norwegian Road Accident Registry. The recorded data include the national identification number of the subject in addition to information about the accident. Data on biological samples submitted for forensic analysis of alcohol and drugs at the Norwegian Institute of Public Health (NIPH) are recorded in the Forensic Toxicology Database at NIPH. This database contains the national identification number together with analytical results for each blood sample taken in police investigations from the whole country. In addition, analytical data from samples taken from legal autopsies from all regions of the country except Trøndelag in central Norway (which comprises two counties and 8.7% of the total population in Norway) are included in this database. A new dataset was generated by Statistics Norway by coupling these two databases, selecting drivers of cars and vans who had been killed in road traffic accidents in Norway from January 2006 to December 2008. Cases with time lapse between accident and death of more than one day were excluded.

In the period 2006-2008, a total of 328 drivers of cars and vans at the age of 18 years or older were killed in road traffic accidents in Norway. Blood samples were submitted to NIPH for analysis of alcohol and drugs in 193 of those cases (59%); the data presented in this report are based on those cases only. Blood samples were taken shortly after the accident from 100 drivers and during legal autopsy of 93 drivers.

The country was divided into three regions as shown in Figure 1. About 53% of the cases were from south-east, 25% from south-west, and 22% from middle/north. As comparison, in December 2008 about 54% of all cars and vans were owned by drivers in south-east, 23% in south-west, and 23% in middle/north according to Statistics Norway (www.ssb.no).

Of the samples analysed, 42% were from drivers killed in single-vehicle accidents, and 58% from collisions with another vehicle. The vast majority of the accidents occurred on rural roads (Table 1).

Table 1. Distribution of the included killed drivers (%) in relation to road type from the three regions of Norway.

Road type	South-east	South-west	Middle/north	Total
Urban	16.5	8.5	11.6	13.5
Rural	83.5	91.5	88.4	86.5
Total	100.0	100.0	100.0	100.0

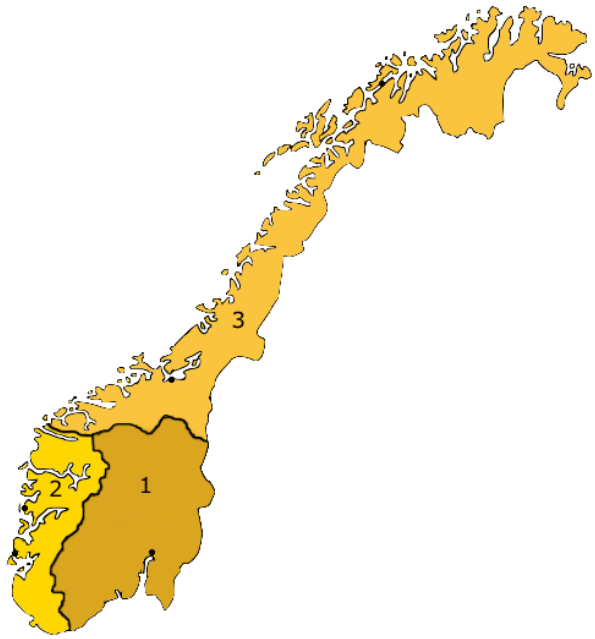

Figure 1. Map showing the study regions. 1: South-east, 2: South-west, and 3: Middle/north.

The distribution of included killed drivers for each season is presented in Table 2 which shows that about 50% more drivers were killed in the 4th quarter compared to the 1st quarter.

Table 2. Distribution of included killed drivers (%) by season

January - March	April – June	July - September	October - December
21.2	22.8	25.4	30.6

The distribution of included killed drivers for each time period is presented in Table 3 together with data on normal traffic obtained from the Norwegian Public Roads Administration. A higher proportion of the fatal accidents occurred during weekend nights and mornings (15.0%) compared to normal traffic at this time (6.1%), and a somewhat lower proportion of the fatal accidents occurred during weekday afternoons (17.6%) compared to normal traffic (23.1%). For other time periods there was no marked difference between killed drivers and normal traffic.

Table 3. Distribution of included drivers (%) by the eight time periods compared with normal traffic

Time period no.	Day and time	Normal traffic	Killed drivers
1	Mon-Fri, 04-9.59	15.0	15.5
2	Mon-Fri , 10-15.59	26.6	24.9
3	Mon-Thu, 16-21.59	23.1	17.6
4	Mon-Thu, 22-23.59 Tue-Fri, 00-03.59	5.9	5.2
5	Sat-Sun, 04-9.59	1.5	5.2
6	Sat-Sun, 10-15.59	8.0	4.7
7	Fri-Sun, 16-21.59	15.3	17.1
8	Fri-Sun, 22-23.59 Sat-Mon, 00-03.59	4.6	9.8

The distribution by age and gender is presented in Table 4 (please note that the age intervals for the groups are different). Only about 21% of the killed drivers were women, although females contribute to about 34% of the traffic volume (1). About 29% of the killed drivers were aged 18-24 years; this age group contributes to only about 8% of the traffic volume (1).

Table 4. Distribution of included killed drivers (%) by age (years) and gender

Gender	18-24 y	25-34 y	35-49 y	50+ y	Total
Female	4.1	4.1	6.7	6.2	21.2
Male	24.9	15.0	15.0	23.8	78.8
Total	29.0	19.2	21.8	30.1	100.0

2.2 Methods

If blood sampling was done shortly after the accident, venous blood was taken using 5 ml Vacutainer® tubes containing sodium fluoride and heparin (BD Vacutainer Systems, Belliver Industrial Estate, Plymouth, UK). In these cases, the average time between accident and blood sampling was 5.5 h (range 0.7-22.7h). The patient was alive at the time of accident in 8 of these cases, for those the average time between accident and sampling was 4.2h (range 1.3-7.3h).

For legal autopsy samples, blood was transferred to Sterilin tubes (Bibby Sterilin, Staffordshire, UK) containing potassium fluoride. Samples were preferably taken from the femoral vein; if this was impossible, blood was taken from the heart. The average time between accident and autopsy was 2.5 days (range 1-18 days).

Blood samples were kept at 2-8°C from the arrival at NIPH until the analyses had been performed, normally within 4 weeks, and thereafter frozen at about -20°C. The blood samples were handled using normal routine procedures for forensic toxicology analysis.

Blood samples from all cases were screened for alcohol using an enzymatic method (2), and if alcohol was found, the concentration was quantified using gas chromatography (3).

Samples of blood were also initially screened for amphetamines, cannabinoids, cocaine metabolites, and opiates by an immunological method (4). Screening for other drugs (see Table 6) was performed using high-performance liquid chromatography with mass

spectroscopy detection (LC-MS) (5). Drug findings were confirmed and quantified using gas chromatography with mass spectroscopy detection (GC-MS) or LC-MS (5-8).

All samples which had more than 3.0 mL blood left after the routine forensic toxicology testing programme (n=162) were re-analysed using UPLC-MS-MS (9) in order to comply with the drugs and cut-off concentrations listed in the Summary Report. Analytical results from the initial testing were complemented with results from re-testing.

The laboratory was accredited according to ISO 17025 for performing the confirmation and quantification methods for forensic toxicology purposes by the Norwegian body for accreditation of laboratories (Norsk Akkreditering, Kjeller, Norway).

Statistical analysis was carried out using SPSS 14.0 (SPSS Inc., Chicago, IL, USA).

2.3 Missing cases

Out of the whole population of killed drivers, toxicological analyses were performed for 61% of the killed drivers in south-eastern Norway, 68% of those in south-western Norway, and 47% of those in middle/northern Norway. Of those from middle/north, samples were received from 32% of killed drivers in Trøndelag (middle region); thus, samples from this area were particularly under-represented since most autopsy samples from that region were analysed by a regional laboratory and not by NIPH. Analytical data from that laboratory were not available for this study.

Toxicological analyses were performed for 68% and 55% of drivers killed during weekends and working days, respectively, for 62% and 57% of those killed in single vehicle accidents and in collisions, respectively, and for 60% and 56% of killed male and female drivers, respectively. The frequencies of toxicological analysis were 56.1%, 60.4% and 60.2% for drivers killed in 2006, 2007 and 2008, respectively, and 54.7%, 62.0%, 60.5% and 58.4% for drivers killed during the first to the fourth quarter of the year, respectively.

The blood samples submitted for analysis in relation to age are presented in Table 5. Drivers below 35 years of age were more frequently investigated for alcohol and drug use than older drivers.

It is likely that some sampling bias occurred when the police decided whether or not a blood sample should be taken from the killed driver, and whether or not a legal autopsy should be performed. The magnitude of the possible bias effect is not known. Confounders like age, gender and time period of the week may affect the overall findings, but those factors were taken into account when presenting analytical results.

Table 5. Frequency of toxicological analysis in relation to age group

	18-24 y	25-34 y	35-49 y	50+ y	Total
Toxicological analyses performed (%)	67.9	66.7	57.7	50.0	58.8

2.4 Results

An overview of the substances found in our study is presented in Tables 6-7, and details on analytical findings in relation to geographical region, road type, day or night, weekday or weekend, accident type, age and gender are presented in Tables 8-9.

Alcohol and/or drugs were found in samples from 38.9% of the drivers; from 64.2% of drivers killed in single vehicle accidents and 20.5% of drivers killed in multiple vehicle accidents. Alcohol was detected in samples from 25.4% of the drivers. Of these ones, 94% had blood alcohol concentrations above 0.5 g/L and 59% above 1.5 g/L.

The most commonly found group of medicinal drugs was the benzodiazepines, and the most commonly found illicit drug group was amphetamines. THC was also frequently detected, while the use of cocaine was confirmed in only one case by finding the degradation product benzoylecgonine.

Drug concentration in autopsy samples may not reflect the concentrations at time of death because of possible post-mortal changes (10, 11). Therefore, the interpretations of drug concentrations may be unreliable.

Amphetamines were found in blood samples from 13 drivers (6.7%); 9 drivers (4.7%) were positive for amphetamine, 9 (4.7%) for methamphetamine, and 2 (1.0%) for MDMA. Amphetamine is a metabolite of methamphetamine and also found in preparations of methamphetamine on the illegal market, so most of the amphetamine detections were not related to the use of pure amphetamine. Amphetamine and/or methamphetamine were found in 11 cases (5.7%), and the concentration of amphetamine was higher than the concentration of methamphetamine in only three of these cases. In 10 of these cases the concentration of amphetamine plus methamphetamine was more than 200 ng/mL, which is higher than concentrations found after therapeutic use of amphetamines (10).

THC was found in samples from 11 drivers (5.6%); 9 and 5 drivers had concentrations above 2 and 5ng/mL, respectively. It has previously been suggested that blood drug concentrations of THC above 2-5 ng/mL (or twice as high in serum) are associated with impairment (12, 13).

Benzodiazepines were found in samples from 21 drivers (10.9%); benzodiazepines on the core drugs list in 17 cases (8.8%), and on the additional drugs list in 4 cases. The most frequently found compounds were diazepam and/or the pharmacologically active metabolite nordiazepam in 8 cases (4.1%); nordiazepam is not marketed as a drug in Norway. The concentration of diazepam exceeded 200 ng/mL in three cases (1.6%); this can be regarded as high therapeutic or supra-therapeutic use (14). Oxazepam was found in 5 cases (2.6%), exceeding 500 ng/mL in one case.

Hypnotics or their degradation products were found in samples from 14 drivers (7.3%); hypnotics on the core drugs list in 8 cases and on the additional drugs list in 7 cases. Zopiclone was the most frequently found hypnotic drug (7 cases). Hypnotics may affect driving skills for several hours after use, also when having normal therapeutic drug concentrations in blood. It has previously been found that plasma concentrations of zopiclone were above 25 ng/mL for about four hours after taking a therapeutic dose of 7.5 mg (15). Based on a plasma/blood ratio of 1.0 (16), this therapeutic dose corresponds to a blood concentration of 25 ng/mL. Four of the drivers had blood zopiclone concentrations above 25 ng/mL.

A total of 28 drivers (14.5%) were positive for more than one substance (including core drugs and additional drugs). The combination of two or more psychoactive substances may affect driving safety even if the concentration of each substance would not affect driving performance significantly if taken alone.

Table 6. Analytical results for core substances

Substance	No. analysed	No. positive	%*
Alcohol	193	49	25.4
Illicit drugs			
Amphetamines	180	13	6.7
Amphetamine	180	9	4.7
Methamphetamine	180	9	4.7
MDMA	180	2	1.0
MDEA	143	0	0.0
MDA	174	1	0.5
Cocaine/benzoylecgonine	179	1	0.5
Cocaine	179	0	0.0
Benzoylecgonine	171	1	0.5
Cannabis	179	11	5.6
THC	179	11	5.6
THCCOOH	0	n/a	n/a
Illicit opiates	179	0	0.0
Monoacetylmorphine	169	0	0.0
Morphine + codeine (< morphine)	179	0	0.0
Medicinal drugs			
Benzodiazepines	182	17	8.8
Diazepam/nordiazepam	182	8	4.1
Diazepam	182	6	3.1
Nordiazepam	182	8	4.1
Oxazepam	182	5	2.6
Lorazepam	157	0	0.0
Alprazolam	182	3	1.6
Flunitrazepam	182	0	0.0
Clonazepam	165	4	2.1
Z-drugs	182	8	4.1
Zolpidem	182	1	0.5
Zopiclone	182	7	3.6
Opiates and opioids	179	3	1.6
Morphine	179	2	1.0
Codeine	179	1	0.5
Methadone	182	0	0.0
Combinations			
Alcohol-drugs	182	13	6.7
Multiple drugs	180	13	6.7

* % of all samples received for analysis (n=193).

Table 7. Analytical results for additional substances

Substance	No. analysed	No. positive	%*
7-aminoflunitrazepam	165	2	1.0
7-aminoclonazepam	182	4	2.1
Nitrazepam	182	2	1.0
7-aminonitrazepam	165	6	3.1
Carisoprodol	182	0	0.0
Meprobamate	182	0	0.0

Table 8. Prevalence (%) of alcohol and drugs in relation to gender and age

Females (n=41)	18-24 y	25-34 y	35-49 y	50+ y	Total
Core substances					
Alcohol ≥ 0.1 g/L	12.5	12.5	23.1	0.0	12.2
Amphetamines	0.0	0.0	7.7	0.0	2.4
Benzoylecgonine	0.0	0.0	0.0	0.0	0.0
Cocaine	0.0	0.0	0.0	0.0	0.0
THC	0.0	0.0	0.0	0.0	0.0
Illicit opiates	0.0	0.0	0.0	0.0	0.0
Benzodiazepines	12.5	0.0	0.0	16.7	7.3
Z-drugs	12.5	0.0	0.0	16.7	7.3
Medicinal opioid/opiates	12.5	0.0	7.7	0.0	4.9
Drug-Alcohol	12.5	0.0	0.0	0.0	2.4
Drug-Drug	12.5	0.0	7.7	8.3	7.3
Additional substances	0.0	0.0	0.0	0.0	0.0
Core and/or additional substances					
Illicit drugs	0.0	0.0	7.7	0.0	2.4
Medicinal drugs	37.5	0.0	7.7	25.0	17.1
Presence of any substance	37.5	12.5	30.8	25.0	26.8
Males (n=152)	**18-24 y**	**25-34 y**	**35-49 y**	**50+ y**	**Total**
Core substances					
Alcohol ≥ 0.1 g/L	37.5	34.5	34.5	13.0	28.9
Amphetamines	8.3	13.8	13.8	0.0	7.9
Benzoylecgonine	0.0	3.4	0.0	0.0	0.7
Cocaine	0.0	0.0	0.0	0.0	0.0
THC	10.4	13.8	6.9	0.0	7.2
Illicit opiates	0.0	0.0	0.0	0.0	0.0
Benzodiazepines	4.2	20.7	17.2	2.2	9.2
Z-drugs	0.0	0.0	6.9	6.5	3.3
Medicinal opioids/opiates	0.0	0.0	0.0	2.2	0.7
Drug-Alcohol	14.6	13.8	0.0	2.2	7.9
Drug-Drug	0.0	13.8	17.2	2.2	6.6
Additional substances	2.1	10.3	10.3	4.3	5.9
Core and/or additional substances					
Illicit drugs	16.7	31.0	17.2	0.0	14.5
Medicinal drugs	6.3	20.7	24.1	13.0	14.5
Presence of any substance	41.7	55.2	58.6	23.9	42.1

A higher proportion of the samples from middle and northern Norway was positive for alcohol or illicit drugs than of the samples from other parts of the country. A higher proportion was positive for alcohol or drugs if the accident happened in urban areas. The speed limit in urban areas is lower than in rural areas, so it is likely that many of these drivers were speeding or driving aggressively as the outcome of the accident was fatal. This may often have been related to the use of alcohol or drugs.

Table 9. Prevalence (%) of alcohol, illicit drugs and medicinal drugs among killed drivers (core and additional substances)

	Alcohol	Illicit drugs	Medicinal drugs	Presence of any substance
Norway in total (n=193)	25.4	11.9	15.0	38.9
South-east (n=103)	21.4	10.7	16.5	35.0
South-west (n=47)	25.5	12.8	14.9	40.4
Middle/north (n=43)	34.9	14.0	11.6	46.5
Urban roads (n=26)	38.5	19.2	23.1	57.7
Rural roads (n=167)	23.4	10.8	13.8	35.9
Day (n=164)	16.5	10.4	14.0	31.1
Night (n=29)	75.9	20.7	20.7	82.8
Week (n=122)	13.1	9.8	18.9	32.0
Weekend (n=71)	46.5	16.9	8.5	50.7
Single vehicle accidents (n=81)	50.6	19.8	19.8	64.2
Multiple vehicle accidents (n=112)	7.1	6.3	11.6	20.5

Alcohol and illicit drugs were particularly often found in samples from drivers killed at night-time and during weekends, while medicinal drugs were more frequently found in samples from those killed during weekdays than during the weekend. Alcohol and illicit drugs were more frequently found in samples from male drivers than female drivers, and more frequently in samples from young drivers than older ones. Medicinal drugs were more frequently found in samples from older drivers; there was no difference between males and females.

A higher proportion of samples from drivers killed in single vehicle accidents were positive for alcohol or drugs than in samples from drivers killed in collisions. This is expected because in collisions the killed driver cannot always be blamed for the accident; the surviving driver might in many cases be responsible.

2.5 Discussion

We received blood samples for analysis of alcohol and drugs from 59% of all drivers of cars and vans killed in Norway during the study period. We expect that sampling was not performed if the police considered that the probability of finding alcohol or drugs was low, but other practical matters as economy and transportation over long distances to obtain an autopsy might also have contributed to a somewhat low frequency of toxicological testing.

The prevalence of alcohol and/or drugs in blood samples from drivers killed in Norway was 37% in 1989-90 and 42% in 2001-2 (17, 18), which is similar to the finding presented in this report. There seems thus not to have been any marked change over the last decades.

The most frequently found drugs in samples from killed drivers during 2006-8 were the same as those found in blood samples from suspected drugged drivers. In 2007, the most frequently detected drug in blood samples from suspected drugged drivers were

diazepam (found in 29% of the samples), THC (27%), amphetamine (27%), and methamphetamine (21%) (19). During the last years there has been a shift from amphetamine to methamphetamine on the Norwegian illicit drug market. The ratio between methamphetamine and amphetamine detections increased from about 1:4 in 2001 to 4:3 in 2009 (20). Our study of killed drivers from 2006-8 reflects this trend.

When comparing with drugs found in the roadside survey (See D2.2.3 Summary Report), a marked difference in the prevalence of alcohol and drugs can be observed. The prevalence of alcohol in samples of oral fluid from random drivers in Norway was very low; only about 0.3% had alcohol concentrations equal to or above 0.1 g/L. Marked differences were also found for most drugs, and particularly for the use of two or more psychoactive substances. It is thus evident that the use of alcohol or a combined use of two or more psychoactive substances may cause particularly high risks for involvement in a fatal road traffic accident.

2.6 Acknowledgements

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3 Country Report Portugal

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3.1 Description of the killed driver sample

According to the Portuguese Road Traffic Law, a test for alcohol and drugs (narcotic and psychotropic substances) must be performed on all drivers and pedestrians killed in road accidents.

The Penal Code stipulates also that the Court may request the screening for other substances that affect the ability to drive, other than those included in routine enforcement activities carried out by the police.

As established by the Law 45/2004, the National Institute of Legal Medicine (from now designated INML, IP) is responsible for the medico-legal autopsies, which are mandatory in the cases of drivers killed in immediate fatal accidents. For the toxicological analysis, the biological samples are collected in accordance with technical recommendations defined to ensure the integrity and identity of the samples and therefore the medico-legal value of the results. The postmortem samples collected for analysis of alcohol, illicit and medicinal drugs are usually the cardiac and peripheral blood. The analyses are performed by the Departments of Forensic Toxicology of the INML, IP.

The cases selected for the present study were that ones with information of road accident in which the driver was the victim and the toxicological analysis previously requested included alcohol, illicit drugs and medicinal drugs (benzodiazepines).

To the toxicological results obtained previously, additional information was obtained such as: age and gender of the driver, month, day and time of the accident and time from accident to death.
All analyses were performed in the Departments of Forensic Toxicology of the INML, IP using the routine validated methods with limits of detection (LOD) and quantification (LOQ) for the core substances, provided in Deliverable D 2.1.2 (Uniform design and protocols for carrying out case-control studies).

3.1.1 Geographical distribution

According to the Portuguese law, autopsies of victims of fatal road accidents were performed by Court order in one of the three Branches or in one of the Medico-Legal Offices (*Gabinetes Médico Legais*, GML) of the INML, IP (Fig. 1).

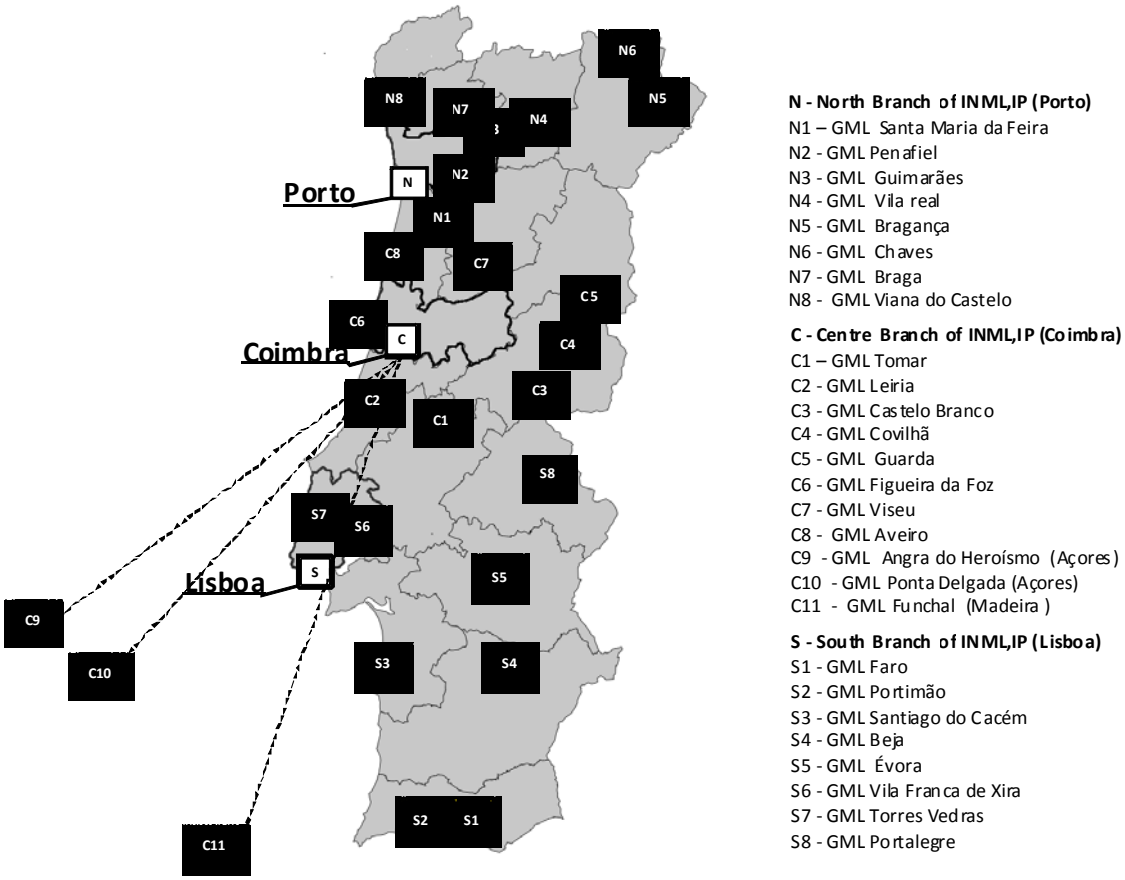

Figure 1 . Distribution of Branches and Medico-Legal Offices of the INML, IP

3.1.2 Road Type

Information about road type, use of seatbelt or other aspects related to the circumstances of the accident are part of the police investigation process to which the INML, IP has no access.

3.1.3 Region

The cases included in this study (n=290) correspond to drivers, victims of fatal road accidents occurred in 2009 and on which postmortem analyzes were carried out in Centre and South Branches of the INML, IP (Table 1). The data presented include 79% of the total killed drivers autopsied in INML during the year 2009.The sampling distribution is different from the one obtained in the Road Side Survey because covers all Municipalities of the Centre and South regions, an area where lives about 71% of Portuguese population.

Table 1. Distribution of killed drivers by region.

Region	Inhabitants (1)	Killed drivers
Centre	2385891	123 (42.4 %)
South	4754736	167 (57.5%)

(1) Year 2006 (Source: Instituto Nacional de Estatística)

3.1.4 Season, day and time period

Under the criteria established in Deliverable D 2.1.2, the cases were distributed by season, day and time period (Tables 2, 3 and 4).

Table 2. Distribution of killed drivers by season.

Season	Killed drivers
Winter (month 1-3)	63 (21.7%)
Spring (month 4-6)	70 (24.1%)
Summer (month 7-9)	88 (30.3%)
Autumn (month 10-12)	69 (23.8%)

Table 3. Distribution of killed drivers by day.

Day	Killed drivers
Sunday	47 (16.2%)
Monday	35 (12.1%)
Tuesday	36 (12.4%)
Wednesday	24 (8.3%)
Thursday	34 (11.7%)
Friday	31 (10.7%)
Saturday	38 (13.1%)
Unknown	45 (15.5%)

Table 4. Distribution of killed drivers by time period.[(1)]

Time period	Killed Drivers
1	37 (12.8%)
2	45 (15.5%)
3	34 (11.7%)
4	24 (8.3%)
5	19 (6.6%)
6	15 (5.2%)
7	36 (12.4%)
8	25 (8.6%)
Unknown	55 (19.0%)

Weekday:
1- Monday to Friday 04:00 to 10:00
2- Monday to Friday 10:00 to 16:00
3 - Monday to Thursday 16:00 to 22:00 **4** - Monday to Thursday 22:00 to 04:00

Weekend:
5 – Saturday and Sunday 04:00 to 10:00
6 – Saturday and Sunday 10:00 to 16:00
7 – Friday to Sunday 16:00 to 22:00
8 – Friday to Sunday 22:00 to 04:00

3.1.5 Gender and Age

Table 5 represents the distribution of killed drivers by gender and age group.

Table 5. Distribution of killed drivers by gender and age group.

Age group	Gender		
	male	female	Total
15-24	45 (17.2%)	4 (20%)	49 (17.4%)
25-34	65 (24.8%)	6 (30%)	71 (25.2%)
35-49	69 (26.3%)	8 (40%)	77 (27.3%)
>=50	83 (31.7%)	2 (10%)	85 (30.1%)
Total	262	20	282*
*Note: Information about age (7 cases) and gender (1 case) was unknown			

3.2 Data collection and analysis

3.2.1 Ethical approval

Following the approval by the Ethics Committee of the Faculty of Medicine of the University of Coimbra, this survey was performed without any information about identities of the killed drivers.

3.2.2 Biological samples and storage

Blood samples were collected during the autopsy by the forensic pathologist in polyethylene tubes containing sodium fluoride (2%) and preserved at -15 °C until toxicological analysis.

3.2.3 Analytical methods

All the core substances were screened by methods fully validated, including specificity and capacity of identification, limit of detection (LOD), limit of quantification (LOQ), recovery, carryover, linearity, intra-assay precision and inter-assay accuracy. The results of the validation for each group of substances are:

Alcohol*

Substance	LOD (g/L)	LOQ (g/L)	Intermediate Precision (CV %)	Linearity	Intra-assay precision (%)	Inter-assay accuracy (%)
Ethanol	0.02	0.06	5.7	(0.1 – 5.1 g/L) Y=0.4462x+0.0044 R^2=0.9999	4.7	102.2
* Extraction: HS		Method: HS-GC-FID				

Illicit Drugs*: Cannabis; Amphetamines; Cocaine

Substance	LOD (ng/mL)	LOQ (ng/mL)	Recovery (%)	Linearity	Intra-assay precision (%)	Inter-assay accuracy (%)
THC	2	5	51.7	(5-500 ng/mL) Y=0.004x+0.0146 R^2=0.995	3	94.9
THCCOOH	2	5	44.1	(5-500 ng/mL) Y=0.0048x-0.0003 R^2=0.9989	3	89.8
Amphetamine	8	23	88	(25-1000 ng/mL) Y=0.0019x-0.0001 R^2=0.996	4	99.7
MDA	3	9	95	(25-1000 ng/mL) Y=0.0025x-0.0353 R^2=0.998	4	99.7
MDEA	3	8	93	(25-1000 ng/mL) Y=0.0034x-0.0724 R^2=0.998	4	99.9
Methamphetamine	4	13	94	(25-1000 ng/mL) Y=0.0027x-0.0342 R^2=0.994	4	100.3
MDMA	7	20	96	(25-1000 ng/mL) Y=0.0012x-0.0155 R^2=0.9982	2	103.6
Benzoylecgonine	2.8	8.4	90.3	(25-1000 ng/mL) Y=0.0029x-0.0247 R^2=0.9982	3	99.5
Cocaine	2.7	8.3	84.5	(25-1000 ng/mL) Y=0.0046x-0.0151 R^2=0.999	3	102
* Extraction: SPE Method: GC-MS						

Medicinal Drugs*: Benzodiazepines; Opiates

Substance	LOD (ng/mL)	LOQ (ng/mL)	Recovery (%)	Linearity	Intra-assay precision (%)	Inter-assay accuracy (%)
Diazepam	0.21	0.65	99	(1-400 ng/mL) Y=0.0166x+0.0685 R^2=0.9954	6.2	97.7
Nordiazepam	0.37	1.12	91	(1-400 ng/mL) Y=0.0068x+0.0536 R^2=0.9968	6.7	96.1
Alprazolam	0.26	0.79	94	(1-400 ng/mL) Y=0.0054x+0.0175 R^2=0.9956	7.9	96.2
Clonazepam	0.52	1.58	97	(1-400 ng/mL) Y=0.0048x+0.0421 R^2=0.9940	4.5	100.9
Oxazepam	0.38	1.16	95	(1-400 ng/mL) Y=0.0111x+0.0141 R^2=0.9954	5.3	97.2
Lorazepam	0.38	1.14	95	(1-400 ng/mL) Y=0.0048x+0.041 R^2=0.9969	8.6	99.1
Flunitrazepam	0.31	0.94	97	(1-400 ng/mL) Y=0.0112x-0.0035 R^2=0.9932	5.7	97.1
Morphine	4.8	14.5	78.8	(25-1000 ng/mL) Y=0.0019x+0.007 R^2=0.9964	4	100.8
Codeine	1.4	4.2	85.3	(25-1000 ng/mL) Y=0.0021x-0.0161 R^2=0.9978	3	96.7
* Extraction: SPE			Method: GC-MS (Opiates); LC-MS/MS (Benzodiazepines)			

3.2.4 Other collected data

Aditional information such as: age and gender of the driver; month, day and time of the accident, time from accident to death, was obtained from pathologist process. Informations about road type, use of seatbelt or other informations related to the circunstances of the accident were not available.

3.2.5 Statistical analysis

Statistical analysis was performed with standard Excel software without application of any correction or weighing factor.

3.3 Non-response (Representativeness)

To permit a comparative analysis of the results obtained in other countries, the cases of drivers killed in immediate fatal accidents in which analysis was performed only for alcohol or only for alcohol and illicit drugs were excluded from this study. Although the number of fatal road accidents occurred in 2009 in Portugal is higher than the number of cases included in this study; the data presented include 79% of the total killed drivers autopsied in INML during the year 2009.

A comparative analysis of the results at National level is not possible as there are no previous studies available with aggregated data in accordance to the criteria used in this study.

3.4 Results

The cases selected for the present study were that ones with information of road accidents in which the driver was the victim and the toxicological analysis previously requested included alcohol, illicit drugs and medicinal drugs (benzodiazepines). The screening analyses included all the core substances and the positive results were aggregated according to the substance classes established in the project.

3.4.1 Distribution of cases by substance group and region

The results presented in Table 6 include a total of 290 drivers killed in an immediate fatal accident occurred in all the Municipalities of Centre and South Regions of Portugal in 2009. In 54.5% of the accidents in the Centre Region and 43% of the accidents in the South Region, at least one psychoactive substance with influence on the ability to drive was detected.
Among drivers victims of fatal accident in Central and South Regions 44.5% revealed the presence of alcohol in blood. The presence of drugs was observed in 9.9% while the consumption of alcohol in association with, at least, one drug, was observed in 5.9% of drivers tested.

Table 6. Distribution of cases by substance group and region.

		Centre Region	South Region	Total
Number of cases		123	167	290
Number of Positive Cases		67 (54.5%)	72 (43%)	139 (47.9%)
Alcohol		51.2%	39.5%	44.5%
Illicit Drugs	THCCOOH	3.3	5.4%	4.5%
	Benzoylecgonine	---	1.2%	0.7%
	Cocaine/Benzoylecgonine	0.8%	0.6%	0.7%
Medicinal Drugs	Benzodiazepines	1.6%	2.4%	2%
	Morphine/Codeine	2.4%	1.8%	2%
Various Combinations	Drugs-Alcohol	4.9%	6.6%	5.9%
	Drug-Drug	---	1.2%	0.7%

3.4.2 Distribution of positive cases by substance group and time period

The social and cultural aspects of alcohol and drugs consumption are important factors to be considered when assessing driving under the influence (DUI). For this reason, measures to prevent DUI should be linked with other policies in the context of public health that aim to prevent the consumption of alcohol and drugs among the general population.
The prevalence of psychoactive substances used by drivers may vary considerably by time (month, day of the week and time of the day).

The results obtained show that the prevalence of drivers that tested positive for psychoactive substances as cannabis and alcohol, alone or in association with drugs, was much higher in the accidents occurred at night (22:00 – 04:00) and weekend (Friday - Sunday) (Tables 7 and 8).

Alcohol was detected in 36% of drivers killed in accidents that occurred in the day period. The prevalence observed in accidents that occurred at night (75.5%) is more than twice that was observed in the day period. In accidents that occurred during the weekend 56.8% of drivers were found positive for alcohol, a prevalence higher than that observed during the week (35.8%).

As with alcohol, also the prevalence of drugs is higher in accidents that occurred at night (14.2%) and during the weekend (9.6%) when compared with the day period of the weekdays, 8% and 9.2%, respectively. In accidents that occurred during the night, 8.2% of drivers was positive for cannabis and 2% for cocaine. The results showed also an association of alcohol and drugs in 16.3% of the drivers involved in fatal accidents occurred during the night period.

Table 7. Distribution of positive cases by substance group and time period aggregated into day (time period 1 to 3 and 5 to 7) *vs* night (time period 4 and 8).

Substance Group[(1)]		Time period	
		Day	Night
Alcohol		36%	75.5%
Illicit Drugs	THCCOOH	3.2%	8.2%
	Benzoylecgonine	0.5%	2%
	Cocaine/benzoylecgonine	1.1%	---
Medicinal Drugs	Benzodiazepines	2.1%	2%
	Morphine/Codeine	1.1%	2%
Various Combinations	Drugs-Alcohol	3.2%	16.3%
	Drug-Drug	---	2%

(1) 25 cases of alcohol; 1 case of Benzoylecgonine; 2 cases of THCCOOH; 1 case of benzodiazepines were not included because information about time period was unknown.

Table 8. Distribution of positive cases by substance group and time period aggregated into week (time period 1 to 4) vs weekend (time period 5 to 8).

Substance Group [(1)]		Time period	
		Week	Weekend
Alcohol		35.8%	56.8%
Illicit Drugs	THCCOOH	3.6%	5.3%
	Benzoylecgonine	0.7%	1.1%
	Cocaine/Benzoylecgonine	1.4%	---
Medicinal Drugs	Benzodiazepines	2.1%	2.1%
	Morphine/Codeine	1.4%	1.1.%
Various Combinations	Drugs-Alcohol	5%	7.4%
	Drug-Drug	---	1.1%

(1) 25 cases of alcohol; 1 case of benzoylecgonine; 2 cases of THCCOOH; 1 case of benzodiazepines was not included because information about time period was unknown.

3.4.3 Distribution of positive cases by substance group and age group

Table 9 shows the distribution of male drivers positive cases by age group. Only 20 female drivers (7%) were included in this study and only 3 of them were found positive for alcohol alone.

The mean value of blood alcohol concentration (BAC) on drivers who tested positive for alcohol alone was 1.4 g/L (Table 10) while the mean value of BAC on drivers with a combination of alcohol and drugs was 1.2 g/L.

Over 50% of male drivers in the age group of 25-34 and 35-49 years were found positive for alcohol in blood with the BAC ≥ 1.2 g/L in 69.6% and 57.8%, respectively (Table 10). In these age groups, the mean values of BAC were 1.4 and 1.5 g/L, respectively.

The prevalence of alcohol in young drivers (15-24 years) is also high (36.5%) with 42.1% of them with BAC values ≥ 1.2 g/L and an average BAC of 1.1 g/L. In 8.9% of this group of drivers the presence of alcohol was in combination with other drugs.

All age groups showed drivers who tested positive for drugs. The higher prevalence of cannabis was found in the group aged 15-24 (11.1%) while cocaine was more prevalent in the group 25-34 (3%). This last group also presents a higher prevalence of drivers with cannabis (6.2%), benzodiazepines (3%), opiates (6.2%) and consumption of alcohol in association with drugs (10.8%).

Table 9. Distribution of male drivers positive cases by substance group and age group

Substance Group*		Age group			
		15-24	25-34	35-49	≥ 50
Alcohol		36.5%	58.5%	63.8%	28.9%
Illicit Drugs	THCCOOH	11.1%	6.2%	2.3%	1.2%
	Benzoylecgonine	---	1.5%	1.4%	---
	Cocaine/ Benzoylecgonine	2.2%	1.5%	---	---
Medicinal Drugs	Benzodiazepines	---	3%	2.9%	2.4%
	Morphine/Codeine	----	6.2%	1.4%	1.2%
Various Combinations	Drugs-Alcohol	8.9%	10.8%	7.4%	1.2%
	Drug-Drug	---	1.5%	---	---

*One case of alcohol was not included because information about age was unknown.

Table 10. Distribution of negative and positive cases by BAC and age group.

BAC (g/L)	Age Group*			
	15-24	25-34	35-49	≥ 50
Negative[1]				
< 0.1	11.0%	11.3%	11.3%	21.2%
Positive[2]				
> 0.1	6.7%	13.8%	15.9%	8.8%
BAC group				
0.1-0.49	31.6%	17.9%	15.6%	36.0%
0.5-0.79	10.5%	10.3%	17.8%	8.0%
0.8-1.19	15.8%	2.6%	8.9%	4.0%
≥ 1.2	42.1%	69.6%	57.8%	52.0%
BAC (Mean)	1.1 g/L	1.4 g/L	1.5 g/L	1.4 g/L
	1.4 g/L			

(1) Six cases were not included because information about age was unknown.

(2) One case was not included because information about age was unknown.

Table 11. Distribution of substance concentration in Alcohol-Drug and Drug-Drug positive cases.

Case	Substances
1	Alcohol: 2.40 g/L; Morphine[1]: <14.5 ng/mL; Cocaine: 68 ng/mL; Benzoylecgonine: 650 ng/mL
2	Alcohol: 1.33 g/L; ; THCCOOH 12 ng/mL
3	Alcohol: 1.76 g/L; Morphine[1]: 56 ng/mL;
4	Alcohol: 1.55 g/L; Morphine[1]: 151 ng/mL;
5	Alcohol : 0.57 g/L; THCCOOH 6ng/mL
6	Alcohol : 0.94 g/L; THCCOOH 10ng/mL
7	Alcohol : 2.40 g/L; THCCOOH 18 ng/mL
8	Alcohol: 0.12 g/L; Diazepam 169 ng/mL; Nordiazepam 157 ng/mL
9	Alcohol: 1.54 g/L; THCCOOH 8 ng/mL
10	Alcohol: 1.43 g/L; Diazepam 33 ng/mL; Oxazepam 1.5 ng/mL; Nordiazepam 69 ng/mL; THCCOOH 24 ng/mL
11	Alcohol: 1.31 g/L; Morphine[1]: 345 ng/mL
12	Alcohol: 1.56 g/L; Cocaine: <8.3 ng/mL; Benzoylecgonine: 277 ng/mL
13	Morphine[1] 34 ng/mL; Diazepam: 4.4 ng/mL; Oxazepam: <1.6 ng/mL; Nordiazepam: 23.2 ng/mL; 5.6 ng/mL; 7 amino clonazepam
14	Alcohol: 0.65 g/L; THCCOOH: 6 ng/mL
15	Alcohol: 1.17 g/L; Benzoylecgonine: 89 ng/mL
16	Alcohol: 0.14 g/L; THCCOOH: 95 ng/mL
17	Alcohol: 0.70 g/L; THCCOOH: 6 ng/mL
18	Alcohol: 0.29 g/L; Cocaine: 35 ng/mL; Benzoylecgonine: 73 ng/mL

(1) Free morphine

3.5 Discussion

Data presented in this study include 79% of killed drivers autopsied in INML. These drivers have been victims of accidents occurred in municipalities of the Centre and South Regions of Portugal, where 71% of the Portuguese population lives. So, it can be assumed that these results are representative of the situation regarding killed drivers in Portugal.

The cases which were not included in this study (21%) show a gender and age distribution similar to the one observed in the cases included. So, it is reasonable to assume that there are no confounding effects due to the missing cases.

Alcohol was the most common psychoactive substance, detected in 44.5% of drivers. A concentration above the legal limit (≥0.5 g/L) was found in 34.5% of drivers.

The high mean value of BAC (1.1 to 1.5 g/L) in all age groups reflects the high prevalence of drivers with BAC exceeding 1.2 g/L (42.1% to 69.6%). Although the possibility of postmortem production cannot be completely excluded, these values may suggest that many of those drivers were probably heavy drinkers. Although the effects caused by alcohol depend on age, health status, type and frequency of consumption, tolerance and association with other drugs, these concentrations are clearly associated with situations of impairment to drive.

Drivers who tested positive for drugs and alcohol (5.9%) showed also a high mean value of BAC (1.2 g/L). Although the concentrations found for some drugs are not high, combination with alcohol may result in additive impairing effects on psychomotor performance and greater relative risk of accident. (Table 11)

A high prevalence of alcohol was found especially at night and during the weekend (75.5% and 56.8%, respectively). This was also observed in equivalent studies with serious injured drivers in road accidents [1].

Illicit drugs were detected in 5.9% of the drivers. The most common illicit drugs found were cannabis (4.5%) and cocaine (1.4%).The presence of Δ9-tetrahydrocannabinol (THC) was not detected in any of the positive cases for cannabis. Although the LOD of the method (2 ng/mL) is higher than that stated in the DRUID project (1 ng/mL), the absence of positive cases for THC could also be related to the stability of this substance during storage of samples and the time elapsed between sampling and analysis.

The prevalence of illegal drugs was similar to that described in studies conducted in other countries [2]. Any comparison must take into account the reality of each country regarding the type of substances and consumption habits. In 2009, cannabis and cocaine were also the substances with greater prevalence among Portuguese drivers involved in accidents with injured victims submitted for drug analysis by the Police.[3]. The higher prevalence of positive cases observed in the south region may be justified because it includes the sub-regions of Lisbon and the Algarve who, according to official statistics, show the highest (above the national average) prevalence of drug use. In this sub-regions cannabis is the most consumed substance followed by cocaine [10].

The prevalence of medicinal drugs was 2% for opiates and 2% for benzodiazepines, a prevalence similar to the frequencies found in different countries. None of the positive cases for morphine showed the presence of 6-acetylmorphine so we should admit the possibility in some cases that the presence of morphine could be related with the medical assistance to the injured victims of the accident.

In conclusion, the prevalence for drugs and alcohol found in this study is consistent with literature. [2,4-9]. However, prevalence figures could be hard to compare due to different condition criteria (selections of cases, time trends and local differences in alcohol and drug use habits, patterns and legislation). Studies with the same design and protocol must be carried out periodically in future to enable a comparative analyze about the prevalence of drivers driving under the influence of alcohol and psychotropic substances in Portugal.

3.6 Acknowledgements

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4 Country Report Sweden

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4.1 Description of the killed driver sample

The Swedish sample includes drivers of personal cars and vans that were killed during the year 2008 and died within 24 hours after the accident. In total, the sample includes 157 drivers from which we have toxicological results, this corresponds to about 94 per cent of all drivers.

Guidelines for the survey design are found in Annex 1 of the Summary report. The guidelines that are applicable to killed drivers have been followed to a large extent. The main deviation is that we collected data from drivers killed in the whole country and did not restrict collection to the catchment area of the road side survey. The reason for this was to increase the number of cases. In this report we will show results from the whole country. For the risk calculations that will be presented in a forthcoming report we will restrict the area somewhat.

The distribution of the sample by road type, accident type, vehicle type, quarter of the year, time period, age and gender, are shown in table 1- 6.

Most drivers are killed on rural roads (table1). The reason for this is partly because the traffic volume is larger on rural roads and partly because there is a higher death risk on rural roads due to higher speeds.

Table 1. Distribution of killed drivers by road type. (n = 157).

Road type	Distribution of sample
Rural	85.4%
Urban	14.6%

The distribution of killed drivers by accident type is shown in table 2. Most drivers are killed in multi-vehicle accidents.

Table 2. Distribution of killed drivers by accident type. (n = 156).

Accident type	Distribution of sample
Single-vehicle accident	41.7%
Multi-vehicle accident	58.3%

Almost all of the killed drivers in the sample were driving a personal car, as shown in table 3.

Table 3. Distribution of killed drivers by vehicle type. (n = 157).

Vehicle type	Distribution of sample
Personal car	93.6%
Van	6.4%

The number of killed drivers is relatively stable between quarters of the year. The highest number is found during the third quarter and the lowest during the fourth quarter (table 4).

Table 4. Distribution of killed drivers by quarter. (n = 157).

Season	Distribution of sample
Quarter 1 (Jan-Mar)	26.1%
Quarter 2 (Apr-Jun)	24.2%
Quarter 3 (Jul-Sep)	28.7%
Quarter 4 (Oct-Dec)	21.0%

In comparison with the distribution of traffic volume, the number of killed drivers is strongly overrepresented during weekend nights (period 8). The risk is also substantially increased during weekday nights (period 4).

Table 5. Distribution of killed drivers by time period. (n = 157).

Time period	Distribution of sample
1: Weekday 04-10	12.7%
2: Weekday 10-16	28.0%
3: Weekday 16-22	20.4%
4: Weekday 22-04	4.5%
5: Weekend 04-10	5.1%
6: Weekend 10-16	8.9%
7: Weekend 16-22	9.6%
8: Weekend 22-04	10.8%

The distribution by age category and gender is shown in table 6. Only one driver (male) was under the age of 18. Overall, about 76 per cent of the killed drivers are male. When comparing these data to the distribution of total mileage, where about 70 per cent is carried out by male drivers, no overall large difference can be seen. However, the distribution between males and females varies greatly for different age categories. There is for example a strong over representation of male drivers in the age category 18-24.

Table 6. Distribution of killed drivers by age category and gender (n = 157).

Age category	Males	Females	All
<18 years	0.6%	0.0%	0.6%
18-24 years	19.1%	2.5%	21.6%
25-34 years	8.9%	2.5%	11.4%
35-49 years	14.6%	7.6%	22.2%
50- years	33.1%	10.8%	43.9%
All ages	76.3%	23.4%	99.7%

4.2 Methods: Data collection and analysis

Before the study started, we were in contact with the Regional Ethical Review Board in Linköping. However, since the study only included samples from deceased drivers we did not have to apply for ethical approval.

All people killed in road traffic accidents in Sweden should undergo a post-mortem examination. In practice, about 90 per cent are examined. The examination is carried out

at the National Board of Forensic Medicine and, if possible, samples of blood, urine and sometimes other material are collected and sent to the department of Forensic Toxicology, which performs a toxicological analysis. The list of substances tested for is not standardised and may differ between drivers. Additional analyses were therefore carried out in order to cover the DRUID substances. This was possible in most cases but since the additional analyses were made afterwards, there were no blood samples left for a few drivers. Thus, there are missing values for some substances and drivers. Apart from the core substances listed in the method part of the summary report, the following additional substances were included: tramadol, 7-a-clonazepam, 7-a-flunitrazepam, nitrazepam, 7-a-nitrazepam, carisoprodol, and meprobamate. The first three of these drugs have been included in the international comparisons and are therefore incorporated in the substance groups and classes described below. The results for the last four substances are reported at the end of the results section.

Drivers who died more than 24 hours after the accident were excluded from the sample. Finally, 157 drivers were included in the study.

Blood samples were used for the analyses in most cases. These samples were collected during the post-mortem examination according to a standardised procedure; femoral blood is collected if possible. In some cases, negative screening results from urine have been reported. This was done only when there was no blood left to do complementary analysis. Results from analyses on muscle tissue have also been reported in a few cases when there was not enough blood to conduct the analyses. Since we mainly are interested in whether a drug is present or absent in a driver and not in its actual concentration, inclusion of results from urine and muscle tissue should be acceptable.

The time between death and sampling varies between 1 and about 20 days. In about 80 per cent of the cases, sampling was conducted within a week from the death.

4.2.1 Toxicological analysis of body fluids

The toxicological analysis was performed at the National Board of Forensic Medicine in Linköping, Sweden. The routines for toxicological analysis included a broad analysis for prescription drugs in blood and a screening for drugs of abuse in blood (or in some cases in urine) as well as determination of alcohols and other volatiles.

Immunoassays were used to screen for opiates, amphetamines, cocaine metabolites, and cannabis. Positive results from the screening were confirmed and quantitated in blood by more specific methods using gas chromatography–mass spectrometry with deuterium labeled internal standards. Limit of quantitation (LOQ) was 0.3 ng/mL for tetrahydrocannabinol, the corresponding LOQ for amphetamine and methamphetamine was 20 ng/mL and 5 ng/mL for morphine, codeine and 6-acetyl morphine (1). LOQ for cocaine and benzoylecgonine was 20 ng/mL.

Prescription drugs were determined in blood by capillary column gas chromatography and a nitrogen–phosphorous detection, a method described in more detail elsewhere (2). With this analytical method, quantitative analysis of approximately 200 different pharmaceutical substances is possible. The LOQs differed for different drugs, and were 100 ng/mL for methadone, 50 ng/mL for diazepam, nordazepam, zolpidem, and 7-aminoclonazepam, and 20 ng/mL for zopiclone, alprazolam, and for 7-amino-flunitrazepam. Since some of the thresholds recommended by DRUID could not be met by the routine methods, chromatograms were re-evaluated for peaks corresponding to the DRUID core drugs. Additional analyses in blood were also performed using an LC-

MS-MS method including all DRUID core drugs except THC, at or lower than the recommended thresholds (3).

Volatiles in blood, primarily ethanol, were determined by headspace gas chromatography with a flame ionisation detector as described in more detail elsewhere (4). Each blood specimen (0.1 mL) was diluted 1 + 10 with tert-butanol as the internal standard, transferred into glass vials and immediately made airtight with crimped aluminum cap. All determinations of ethanol were done in duplicate on two chromatographic systems that result in different retention times for ethanol. The mean of duplicate determinations was reported and all concentrations of ethanol in blood less than 0.1 g/L were reported as negative.

The results in this report are based on the DRUID cut-offs (see list of applied cut-offs in the Summary report), even when the LOQ is lower.

4.2.2 Other data

For each subject, we also collected data on age, gender, date and time of accident, vehicle type (personal car or van), accident type (single-vehicle accident or multi-vehicle accident) and road type (rural or urban road).

The time of accident is divided into four groups:

- Weekday: Monday-Thursday: 04.00 – 22.00, Friday 04.00 - 16.00
- Weeknight: Monday-Thursday: 22.00 – 04.00
- Weekend day: Friday: 16.00-22.00, Saturday and Sunday: 04.00 – 22.00
- Weekend night: Friday – Sunday: 22.00 – 04.00

4.2.3 Classification of substances and missing values

The substances are divided in types, groups and classes according to a classification scheme (see the method part of the summary report). This is done in three steps:

1. Substances of the same type are combined into: alcohol, amphetamines, cocaine, cannabis1, cannabis2, illicit opiates, benzodiazepines, Z-drugs, and medicinal opioids and opiates.
2. Substance groups are formed by adding two categories: drug-alcohol and drug-drug combination. Thus, if a subject is positive for two different drug types he or she will be classified as a drug-drug combination.
3. Substance groups are aggregated into the following substance classes: alcohol, illicit drugs, medicinal drugs, drug-alcohol combination and drug-drug combination.

The substance type cocaine1 means that only benzoylecgonine is found but not cocaine. Cocaine2 means that cocaine or a combination of cocaine and benzoylecgonine is found. However, in this country report, we have combined the two groups to one group, called cocaine.

The substance type cannabis1 means that only THC-COOH is found and not THC. This is here regarded as a negative result and therefore not included in the tables. Thus, this differs from the summary report. This difference only has a small effect on the results since all results regarding THC-COOH were negative. However, it does affect the number of drivers included in the results since there were a few missing values of THC-COOH. This was ignored here in the country report (it was regarded as negative) but was considered as missing in the summary report.

The data from the toxicological analysis is incomplete for some of the drivers in the sense that data are missing for one or several substances. One reason for this partial non-response is that there was no blood left to do the complementary analyses. Moreover, if a driver survived a while after the accident and was given morphine during treatment it is not possible to know if morphine was present before the accident. This is also considered as a missing value.

Due to missing values, it is sometimes not possible to decide the status of a specific substance type (amphetamines, illicit opiates, Z-drugs, etc). For example, if the results for zopiclone is missing and results for zoldipem is negative, the result for the type Z-drug is also missing. However, if zoldipem is positive then Z-drugs are also positive even though we do not know the results of zopiclone. A missing value may thus be handled differently depending on the results for the other substances of the same type.

If it is possible to determine the substance group or substance class belonging, even though one or more substance types are missing, then the driver is kept in the data set. Otherwise the driver is removed. Consider the following situations as examples: the driver is positive for alcohol and negative for all other drug types except for illicit opiates where the data is missing. In this case we do not know if the driver belongs to the group alcohol only or drug-alcohol combination and he or she is removed. If, instead, the driver is positive for alcohol and amphetamines but missing on other illicit drugs, then he or she is classified as alcohol-drug combination.

4.2.4 Statistical analysis

The data were processed by the statistical software SAS 9.1.3.

4.3 Non-response

The non-response in this study consists of killed drivers who did not undergo post-mortem examination or where no toxicological analyses were requested.

All people killed in road traffic accidents in Sweden should undergo a post-mortem examination and in general this is done in about 90 per cent of the cases. It is formally the police that request the examination. A reason for not requesting an examination may be that a person was treated in a hospital long after the accident before he or she died. There may also be circumstances of the accident that explain why the police do not request a post-mortem examination. However, we have no knowledge of the specific reasons for not requesting an examination of the drivers in our study.

During the study period, year 2008, 178 drivers of personal cars or vans were killed in road traffic accidents in Sweden and 170 (96%) of these did undergo a post-mortem examination. In 2 of the 170 cases, no toxicological analyses were performed (toxicological results were thus available from 94% of the drivers). Because of the low number of missing drivers it is unlikely that the non-response affects the results of this study more than marginally. Finally, 11 cases were excluded because they died more than 24 hours after the accident, leaving 157 cases for the study.

4.4 Results

Table 7 and table 8 show the overall substance group and substance class distribution. Slightly less than 70 per cent of the drivers are negative for all substances. Alcohol alone is found in 16 per cent of the drivers, which makes it the most common group by far. It

can also be noted that drugs are relatively often taken in combination with other drugs or alcohol.

Table 7. Substance group distribution. Missing data for 12 drivers.

Type	Substance group	Number of drivers	Proportion of drivers (%)
	Negative	100	69.0
Alcohol	Alcohol	23	15.9
Illicit drugs	Amphetamines	4	2.8
	Cocaine	0	0.0
	THC	1	0.7
	Illicit Opiates	0	0.0
Medicinal drugs	Benzodiazepines	0	0.0
	Z-drugs	4	2.8
	Opiates and opioids	1	0.7
Combinations	Drug-alcohol combination	6	4.1
	Drug-drug combination	6	4.1
Total		145	100.1

Table 8. Substance class distribution. Missing data for 12 drivers.

Substance class	Number of drivers	Proportion of drivers (%)
Negative	100	69.0
Alcohol	23	15.9
Illicit drugs	5	3.4
Medicinal drugs	5	3.4
Drug-alcohol combination	6	4.1
Drug-drug combination	6	4.1
Total	145	99.9

In the first two tables, 12 drivers are excluded because of missing values. However, they may only have missing values for one substance group and can be positive for other groups. Complementary information is provided in table 9 where results are shown for one substance type at a time. The number and proportion of positive drivers for each substance type as well as the number of missing values are presented.

The results show that amphetamines are the most prevalent substance type after alcohol, while cocaine and cannabis are relatively rare. The three types of medicinal drugs are used at more or less the same extent. However, Z-drugs are more often used alone and not in combination with other drugs or alcohol.

Note that one driver may be included in several classes. The total number of drivers is 157, the number of missing values for each substance type is presented in the table.

Table 9. Proportion of killed drivers positive for a substance in a specific substance type.

Type	Substance type	Number of positive drivers	Proportion of drivers (%)	Missing values
Alcohol	Alcohol	29	18.8	3
Illicit drugs	Amphetamines	10	6.5	4
	Cocaine	2	1.3	4
	THC	2	1.3	4
	Illicit Opiates	0	0.0	4
Medicinal drugs	Benzodiazepines	6	3.9	2
	Z-drugs	5	3.2	2
	Opiates and opioids	6	4.1	10*

* Includes 6 drivers who were given morphine after the accident.

Table 10 shows the substance group distribution for different time periods. The number of drivers in each group is low, especially for week and weekend nights, so the results must be interpreted with caution. Nevertheless, it can be seen that the proportion of negative drivers is much lower during the nights than during the days. The main reason for the difference is due to alcohol which is much more prevalent during the night.

Table 10. Distribution of substance group by time period. Missing data for 12 drivers.

Type	Substance class	Weekday (n=87)	Weeknight (n=7)	Weekend day (n=35)	Weekend night (n=16)
	Negative	75.9%	14.3%	77.1%	37.5%
Alcohol	Alcohol	10.3%	42.9%	11.4%	43.8%
Illicit drugs	Amphetamines	3.5%	0.0%	2.9%	0.0%
	Cocaine	0.0%	0.0%	0.0%	0.0%
	THC	0.0%	0.0%	2.9%	0.0%
	Illicit Opiates	0.0%	0.0%	0.0%	0.0%
Medicinal drugs	Benzodiazepines	0.0%	0.0%	0.0%	0.0%
	Z-drugs	2.3%	14.3%	0.0%	6.3%
	Opiates and opioids	0.0%	0.0%	2.9%	0.0%
Combinations	Drug-alcohol combination	3.5%	14.3%	2.9%	6.3%
	Drug-drug combination	4.6%	14.3%	0.0%	6.3%
Total		100.1%	100.1%	100.1%	100.2%

The substance group distribution by age category is shown in table 11 (male drivers) and table 12 (female drivers). The age category "< 18 years" only included one driver and is therefore not shown. This driver was male and was found negative for all substances. The proportion of negative drivers is relatively stable for male drivers, except for the category 25-34 years old. This category have a much lower proportion of negative drivers but the difference only depend on a few drivers and no strong conclusions can be drawn from this result.

The prevalence of alcohol and drugs is very low among the female drivers. For example, all but one driver over 35 years old are negative for all substances. However, the total number of killed female drivers is very low and it is not possible to interpret any age differences.

Table 11. Distribution of substance group by age, male drivers. Missing data for 9 drivers.

Type	Substance class	18-24 years (n=29)	25-34 years (n=14)	35-49 years (n=21)	≥50 years (n=46)
	Negative	65.5%	42.9%	61.9%	69.6%
Alcohol	Alcohol	24.1%	21.4%	19.1%	13.0%
Illicit drugs	Amphetamines	3.4%	7.1%	4.8%	2.2%
	Cocaine	0.0%	0.0%	0.0%	0.0%
	THC	3.4%	0.0%	0.0%	0.0%
	Illicit Opiates	0.0%	0.0%	0.0%	0.0%
Medicinal drugs	Benzodiazepines	0.0%	0.0%	0.0%	0.0%
	Z-drugs	0.0%	0.0%	4.8%	4.3%
	Opiates and opioids	0.0%	0.0%	0.0%	2.2%
Combinations	Drug-alcohol combination	3.4%	14.3%	4.8%	2.2%
	Drug-drug combination	0.0%	14.3%	4.8%	6.5%
Total		99.8%	100.0%	100.2%	100.0%

Table 12. Distribution of substance group by age, female drivers. Missing data for 3 drivers.

Type	Substance class	18-24 years (n=4)	25-34 years (n=4)	35-49 years (n=10)	≥50 years (n=16)
	Negative	25.0%	75.0%	90.0%	100.0%
Alcohol	Alcohol	75.0%	0.0%	0.0%	0.0%
Illicit drugs	Amphetamines	0.0%	0.0%	0.0%	0.0%
	Cocaine	0.0%	0.0%	0.0%	0.0%
	THC	0.0%	0.0%	0.0%	0.0%
	Illicit Opiates	0.0%	0.0%	0.0%	0.0%
Medicinal drugs	Benzodiazepines	0.0%	0.0%	0.0%	0.0%
	Z-drugs	0.0%	0.0%	10.0%	0.0%
	Opiates and opioids	0.0%	0.0%	0.0%	0.0%
Combinations	Drug-alcohol combination	0.0%	25.0%	0.0%	0.0%
	Drug-drug combination	0.0%	0.0%	0.0%	0.0%
Total		100.0%	100.0%	100.0%	100.0%

The prevalence of alcohol and drugs are much higher in single-vehicle accidents than in multi-vehicle accidents, see table 13. The difference is most evident for alcohol, drug-alcohol combination and drug-drug combination.

Table 13. Distribution of substance group by accident type. Missing data for 12 drivers.

Type	Substance class	Single-vehicle accident (n=62)	Multi-vehicle accident (n=82)
	Negative	51.6%	81.7%
Alcohol	Alcohol	21.0%	12.2%
Illicit drugs	Amphetamines	4.8%	1.2%
	Cocaine	0.0%	0.0%
	THC	0.0%	1.2%
	Illicit Opiates	0.0%	0.0%
Medicinal drugs	Benzodiazepines	0.0%	0.0%
	Z-drugs	4.8%	1.2%
	Opiates and opioids	0.0%	1.2%
Combinations	Drug-alcohol combination	9.7%	0.0%
	Drug-drug combination	8.1%	1.2%
Total		100.0%	99.9%

4.4.1 Results for additional substances

In Sweden, the following additional analyses were included: carisoprodol, nitrazepam, 7-amino-nitrazepam, and meprobamate. The results show that one driver (out of 155) was positive for Carisoprodol and one (out of 155) for Nitrazepam and 7-amino-nitrazepam. All results were negative for meprobamate.

4.4.2 Concentrations

Substance concentrations are shown for all positive results from the 157 drivers. Minimum, maximum and median concentrations are shown for the substances with at least 5 positive observations, see table 14. Concentrations for the rest of the substances are shown in figure 1 and figure 2. All single concentration values are shown and represented by bars in the diagram. No positive cases were found for: MDMA, MDA, MDEA, clonazepam, lorazepam, flunitrazepam, 7-a-flunitrazepam, and 6-acetylmorphine.

Table 14. Substance concentrations for substances with at least 5 positive observations. Minimum, maximum and median concentrations are shown.

Substance	Number of observations	Min	Max	Median
Alcohol	29	0.13 g/L	3.23 g/L	1.5 g/L
Amphetamine	10	35 ng/mL	4931 ng/mL	445 ng/mL
Zopiclone	5	20 ng/mL	419 ng/mL	60 ng/mL

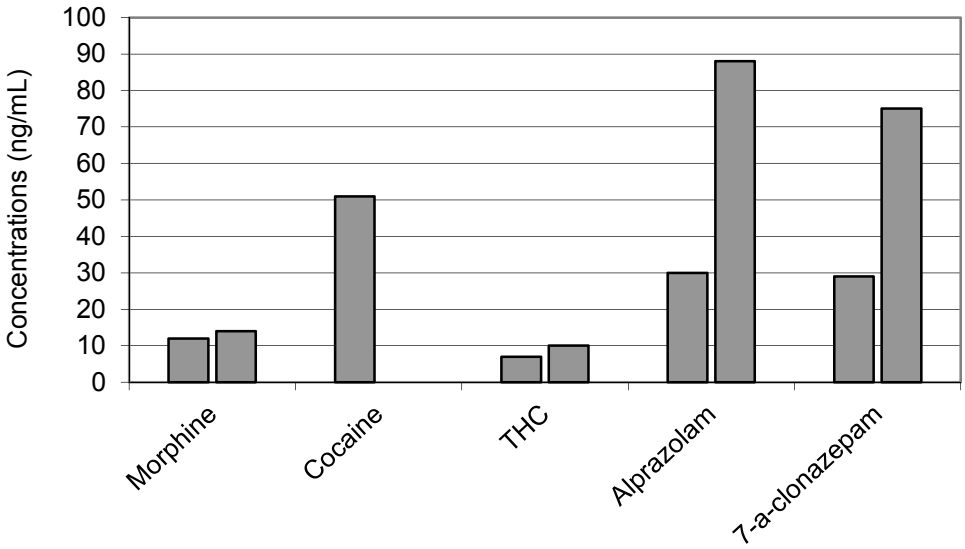

Figure 1. Substance concentrations for substances with less than five positive observations. Each positive observation is represented by one bar in the diagram.

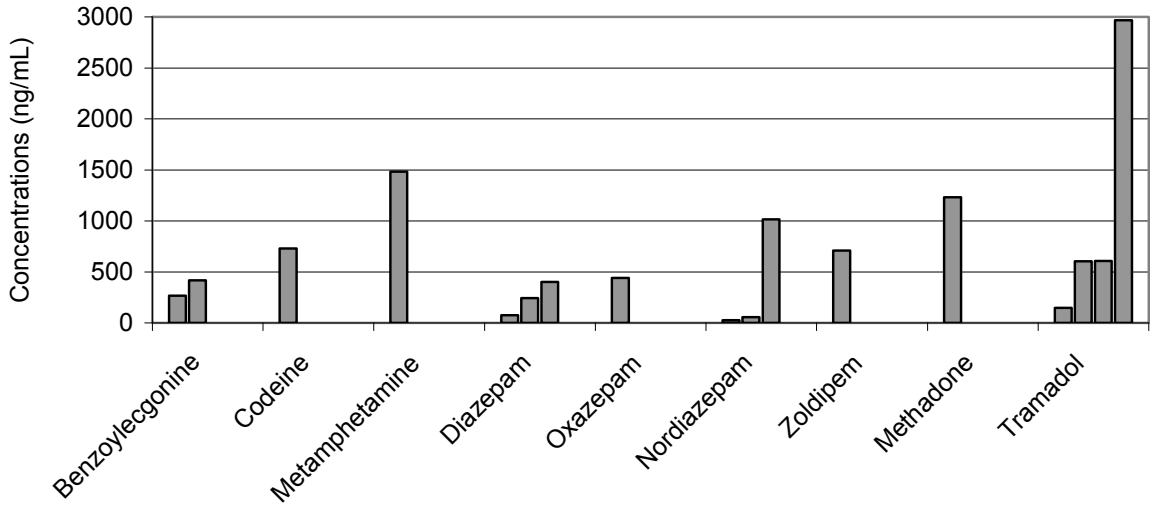

Figure 2. Substance concentrations for substances with less than five positive observations. Each positive observation is represented by one bar in the diagram.

4.5 Discussion of results

The study area covers the whole of Sweden and the representativeness of the sample is very good since almost all killed drivers were included (about 94%). We have no information about the missing drivers, but because of the low number it is unlikely that the non-response affects the results of this study more than marginally.

The results show that slightly more than 30 per cent of all killed drivers were positive for at least one substance. The highest prevalence was found for alcohol, which was found in 20.0 per cent of all drivers (15.9% alcohol alone and 4.1% in combination with one or more drugs). The most prevalent substance type among the illicit drugs was amphetamines. None of the killed drivers were positive for illicit opiates.

Due to the low number of killed drivers, it is difficult to draw any conclusions regarding subgroups of the data. However, the results indicate higher prevalence among male drivers than female drivers, with respect to both alcohol and drugs. Moreover, alcohol and drugs were prevalent in all age categories among male drivers while in the female groups over 35 years, only one subject had positive toxicological findings. The results also show a high prevalence of both drugs and alcohol in single-vehicle accidents.

The high prevalence of alcohol among killed drivers is in agreement with results from previous studies in Sweden. A study of killed drivers during the period 2003-2007 showed that alcohol (over 0.2 g/L) was prevalent in about 22 per cent of the drivers (1). This study also confirms that amphetamines are the most prevalent of the illicit substance types.

4.6 References

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